REMARKS

This amendment and response is responsive to the Office Action of May 23, 2005.

Claim 1 and 3-5 have been objected to because of certain informalities.

Claim 4 has been objected to under 37 CFR 1.75(c) as being of improper dependent form for failing to further limit the subject matter of a previous claim.

Claims 1, 3, 4, 7 and 8 have been rejected under 35 U.S.C. 102(b) as being anticipated by Hosokawa et al.

Claims 5 and 9 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Hosokawa et al. in view of Sizer, II. Claims 11-15 and 18, 19, 21, and 22 have been rejected under the same statutory provision as being unpatentable over Hosokawa et al. in view of Maruko et al. Claims 16 and 17 have been rejected under the same statutory provision as being unpatentable over Hosokawa et al. and Maruko et al. as applied to claim 11 and further in view of Shinmura et al.

By this amendment claims 1, 4, 7, and 11 have been amended. Claim 8 has been canceled.

CLAIM OBJECTIONS

By this amendment, claims 1 and 4 have been amended and are now in proper form. Now claim 4 is dependence of claim 1 and claim 2.

35 U.S.C. 102 REJECTIONS

The original claims 1, 3, 4, 7 and 8 (before this revision) were once rejected under 35 U.S.C. 102(b) as being anticipated by Hosokawa et al. Claim 7 is revised to cover more details that help to understand the method completely.

Claim 2 is restored to describe the features of the "Circumferentially Dual Rotating Pulsed Infrared Laser Scanner" in detail, and abbreviated it as "CDR Scanner" to reduce the burden of carrying such a long name in the entire patent

file. While the main point of Claim 8 has been is transferred to claim 2, hence it is cancelled in this amendment.

Hosokawa et al. disclose a radar apparatus including a rotary polygon mirror with a plurality of mirror surfaces inclined at different angles. A semiconductor laser diode and a collimator lens are disposed above the polygon mirror. An infrared pulse beam emitted from the semiconductor laser diode is reflected by a reflection mirror disposed at an upper position in front of the polygon mirror to reflect the pulse beam obliquely downward toward the rotary polygon mirror so that the pulse beam is reflected as a transmission beam advancing toward a measuring area in a forward direction. A light receiving means receives the transmission beam returned from an object positioned within the measuring area. As shown in FIG. 5, the scanning area 81 includes an area oriented ahead of the vehicle and the scanning angle is limited to 120 degrees by the use of polygon mirror 31 as shown in FIGS. 11A and 11B.

In contrast, and as claimed in amended independent claim 1, the vehicle collision avoidance system of the present invention comprises "a circumferentially rotating pulsed infrared laser beam scanner apparatus including a laser pulsed emitter and an infrared laser sensor for generating a first signal representative of an obstacle scanned, **the laser pulsed emitter rotating circumferentially in a horizontal plane, the infrared laser sensor, rotating circumferentially and synchronously with the laser pulsed emitter in the horizontal plane** and receiving a reflected laser beam signal from the obstacle scanned."

The claimed subject matter of amended independent claim 1 is not anticipated by Hosokawa et al. Attention is drawn to column 5, beginning at line 28, at which the Hosokawa et al. radar apparatus 1 is described. After describing the formation of the transmission beam, it is noted that the transmission beam "is then reflected by the mirror 24 and advances toward the beam reflecting section 30." Col. 5, lines 50-51. Further, the "beam reflecting section 30 comprises, besides the polygon mirror 31, a polygon scanner motor 32 and a circuit board 33 mounting a driving circuit for the polygon scanner motor 32, both of which are disposed under the polygon mirror 31." Col. 5, lines

62-66. Finally, the polygon mirror 31 "is rotated at a constant speed by the polygon scanner motor 32." Col. 6, lines 4-5. Hosokawa et al. therefore do not disclose a laser pulsed emitter rotating circumferentially in a horizontal plane but rather a rotating polygon mirror 31. It is noted that the semiconductor laser diode 21 does not rotate.

Additionally, Hosokawa et al. do not disclose an infrared laser sensor rotating circumferentially and synchronously with the laser pulsed emitter. With reference to FIG. 4 and column 5, lines 29-38, the light receiving element 60 is stationary and accommodated within the housing 10.

Finally, as noted above, and as shown in FIG. 5, the scanning area 81 includes an area oriented ahead of the vehicle and the scanning angle is limited to 120 degrees by the use of polygon mirror 31 as shown in FIGS. 11A and 11B.

As stated by the Federal Circuit:

> Anticipation requires the presence in a single prior art reference disclosure of each and every element of the claim invention, arranged as in the claim.

Lindermann Maschinenfabrik GMBH v. American Hoist and Derrick Co., 221 USPQ 481, 485 (Fed. Cir. 1984). The examiner has not shown that Hosokawa et al. shows "each and every element of the claim invention." Applicant respectfully submits that amended independent claim 1 is not anticipated by Hosokawa et al. Withdrawal of this rejection is respectfully requested.

Dependent claims 3 and 4 depend either directly or indirectly from amended independent claim 1 and include all of the limitations thereof. Withdrawal of this rejection is respectfully requested.

Amended independent claim 7 recites a method of avoiding a vehicle collision comprising "determining features of an obstacle using a circumferentially rotating pulsed infrared laser beam scanner **including a circumferentially rotating laser pulsed emitter and a circumferentially rotating infrared laser sensor**". For the reasons discussed above, Hosokawa et al. do not anticipate the invention as claimed in amended independent claim 7. Withdrawal of this rejection is respectfully requested.

35 U.S.C. 103 REJECTIONS

Claims 5 and 9 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Hosokawa et al. in view of Sizer, II. Sizer, II discloses a Nd: YAG laser for use in a high repetition rate laser source having high power. The Sizer, II Nd: YAG laser is not appropriate for use in a vehicle collision avoidance system because that it does not meet maximum permissible exposure limits (MPE). As recited in claim 5, the circumferentially rotating pulsed infrared laser beam scanner apparatus emits a laser beam having "a wavelength between 1um and 1.550 um excluding the region between 1.3um and 1.4um". Such a laser is not shown or disclosed by Sizer, II, **and the application of his proposed laser, according to the claims in the patent of sizer II, is for telecom communication**. Additionally, claim 5 depends from amended independent claim 1 and includes all of the limitations thereof which are not shown or suggested by the cited references. Withdrawal of this rejection is respectfully requested.

Claim 9 depends from amended independent claim 7 and includes all of the limitations thereof that are not shown or suggested by the cited references. Withdrawal of this rejection is respectfully requested.

While absorbing the key points abstracted from claim 15, 19, 21 and 22, claims 11-14 and claim 18 are revised, with the intention to present a description which is even essential, clear, order, complete and detailed to the readers. As a result, claims 11-14 and claim 18 stay while claims 19, 21 and 22 are hereby canceled.

The original claims 11-14 and claim 18 were once rejected under 35 U.S.C. 103(a) as being unpatentable over Hosokawa et al. in view of Maruko et al. Maruko et al. disclose a braking control system with object detection system interaction . A scanning laser radar sensor is used as the object detector 31 to capture, recognize, sense or detect the preceding vehicle (or relevant target vehicle) or a frontally located object, and to monitor a vehicle-to-vehicle distance (or an inter-vehicle distance or a separating distance between the host

vehicle and the preceding vehicle) or a relative distance L of the frontally located object (or the preceding vehicle) relative to the host vehicle, and to monitor a relative angle theta of the direction of the preceding vehicle's motion or relative to the object. Thus Maruko et al. do not show or suggest the use of a circumferentially rotating pulsed infrared laser beam scanner "including a circumferentially rotating laser pulsed emitter and a circumferentially rotating infrared laser sensor" as recited in amended independent claim 11. Withdrawal of this rejection is respectfully requested.

Amended claims 11 -14 and 18 depend either directly or indirectly from amended independent claim 7 and include all of the limitations thereof. For the reasons discussed above, the cited references do not show or suggest the recited features of the present invention. Withdrawal of this rejection is respectfully requested.

CONCLUSION

All of the claims remaining in the application are in the condition for allowance and an indication to the effect is respectfully requested. The Examiner is invited to contact the undersigned or schedule an interview with any questions regarding the present amendment.

Respectfully submitted,

Baojia Huang

Baojia Huang
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Sunnyvale CA 94087
Tel: 408 739-1888

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on Aug. 11, 2005.

Baojia Huang

Baojia Huang
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1352 Kingfisher Way
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PTOL-413A (09-04)
Approved for use through 07/31/2006. OMB 0651-0031
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Applicant Initiated Interview Request Form

Application No.: 10/613,885 First Named Applicant: Baojia Huang
Examiner: Eric Gibson Art Unit: 3661 Status of Application:

Tentative Participants:
(1) Baojia Huang (2)
(3) Douglas MacKenzie (4)

Proposed Date of Interview: week of July 11, '05 **Proposed Time:** (AM/PM)

Type of Interview Requested:
(1) [X] Telephonic (2) [ ] Personal (3) [ ] Video Conference

Exhibit To Be Shown or Demonstrated: [ ] YES [X] NO
If yes, provide brief description:

Issues To Be Discussed

Issues (Rej., Obj., etc)	Claims/ Fig. #s	Prior Art	Discussed	Agreed	Not Agreed
(1) Rej	1,3-5,7-9 11-19,21 & 22		[ ]	[ ]	[ ]
(2)			[ ]	[ ]	[ ]
(3)			[ ]	[ ]	[ ]
(4)			[ ]	[ ]	[ ]

[ ] Continuation Sheet Attached

Brief Description of Arguments to be Presented:
Distinctions over the prior art.

An interview was conducted on the above-identified application on .

NOTE: This form should be completed by applicant and submitted to the examiner in advance of the interview (see MPEP § 713.01).

This application will not be delayed from issue because of applicant's failure to submit a written record of this interview. Therefore, applicant is advised to file a statement of the substance of this interview (37 CFR 1.133(b)) as soon as possible.

Douglas MacKenzie
Applicant/Applicant's Representative Signature

Examiner/SPE Signature

Douglas E. MacKenzie
Typed/Printed Name of Applicant or Representative

38,955
Registration Number, if applicable

Auto-Reply Facsimile Transmission

TO: Fax Sender at 4084360758

Fax Information
Date Received: 7/6/2005 7:39:10 PM [Eastern Daylight Time]
Total Pages: 2 (including cover page)

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Received Cover Page =======>

07/06/2005 16:59 4084360758 PAGE 01

FORTUNE LAW GROUP LLP

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FACSIMILE TRANSMITTAL SHEET

DATE: July 6, 2005

TOTAL PAGES: 2 (this cover sheet included)

TO:

NAME / COMPANY	PHONE NUMBER	FAX NO.
Eric M. Gibson	(571) 272-6960	(703) 872-9306

FROM:

NAME / COMPANY	PHONE NUMBER	FAX NO.
Douglas Mackenzie /	(408) 436-0789	(408) 436-0758

RE: Applicant Initiated Interview Request Form – Ser. No. 10/613,885

MESSAGE: (please see attached)

FORTUNE LAW GROUP LLP

100 CENTURY CENTER COURT, SUITE 315
SAN JOSE, CA 95112
TEL: 408.436.0789
FAX: 408.436.0758
www.FLGlawyer.com

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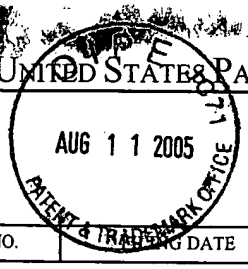
MESSAGE: (please see attached)

UNITED STATES PATENT AND TRADEMARK OFFICE



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/613,885	07/03/2003	Baojia Huang	AWG 001	6866

7590 05/23/2005

FORTUNE LAW GROUP
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100 Century Center Ct
San Jose, CA 95112

EXAMINER	
GIBSON, ERIC M	
ART UNIT	**PAPER NUMBER**
3661	

DATE MAILED: 05/23/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.	Applicant(s)	
10/613,885	HUANG, BAOJIA	
Examiner	**Art Unit**	
Eric M Gibson	3661	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *28 February 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3-5,7-9,11-19,21 and 22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3-5,7-9,11-19,21 and 22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *03 July 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1. Claims 1 and 3-5 are objected to because of the following informalities:

a. In claim 1, at line 6, "plan" should be –plane--.

b. Claims 3-5 are necessarily rejected as being dependent upon a rejected base claim.

Appropriate correction is required.

2. Claim 4 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 4 claims dependence from canceled claim 2.

Claim Rejections - 35 USC § 102

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

3. Claims 1, 3, 4, 7, and 8 are rejected under 35 U.S.C. 102(b) as being anticipated by Hosokawa et al. (US005864391A).

a. As per claim 1, Hosokawa teaches a vehicle collision avoidance system (figure 18) that includes a circumferentially rotating (column 10, lines 62-63) pulsed

infrared laser beam scanner for generating a signal of an obstacle (210, figure 18) by scanning the vertical and horizontal planes simultaneously (see figure 5) and emitting and receiving a reflected portion from the obstacle (column 14, lines 19-22), a processing circuit for processing the signal and generating a plurality of signals (220, figure 18), a processor for processing the plurality of signals and generating a braking signal (200, figure 18), and a braking apparatus responsive to the braking signal (241, figure 18).

b. As per claims 3 and 4, the scanner taught by Hosokawa is "operable to" scan an object from 1.6m to 120m, distances relevant in a collision avoidance system.

c. As per claim 7, Hosokawa teaches a vehicle collision avoidance method (figure 19) that includes determining features of an obstacle using a circumferentially rotating (column 10, lines 62-63) pulsed infrared laser beam scanner (S20, figure 19), processing signals representative of the determined features (S70, figure 19), and braking the vehicle if the proceed signals indicate an imminent collision (S100, figure 19).

d. As per claim 8, Hosokawa teaches scanning horizontally and vertically (figure 5).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 5 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hosokawa in view of Sizer, II (US004737958A).

a. As per claims 5 and 9, Hosokawa teaches the invention as explained in the rejection of claims 1 and 7. Hosokawa does not specify the exact specifications of the laser used in the invention. The use of laser scanners to detect objects in vehicle collision systems is well known in the art. The specific laser used in any application varies depending on the system's requirements. Furthermore, lasers can be *tuned to achieve desired specifications*, as is well known to one of ordinary skill in the art, including mandated *Federal safety specifications*. One such known laser is the "Nd: YAG" laser, exemplified in the description of Sizer. It would have been obvious to one of ordinary skill in the art, at the time of invention, to include a laser well known in the art and tuned as one of ordinary skill in the art would to achieve desired performance qualities, such as the YAG laser, as exemplified in Sizer.

5. Claims 11-15, 18, 19, 21, and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hosokawa in view of Maruko et al. (US20020091479A1).

a. As per claim 11, Hosokawa teaches a vehicle collision avoidance method (figure 19) that includes detecting obstacles using a circumferentially rotating (column 10, lines 62-63) pulsed infrared laser beam scanner (S20, figure 19), determining a relative distance to the obstacle (S30, figure 19), and braking the vehicle if the proceed signals indicate an imminent collision (S100, figure 19). Hosokawa teaches generally applying braking to avoid a collision, but does not teach determining a time to collision

and determining the braking force. Maruko teaches a braking control system with object detection system interaction that teaches determining a time to collision (page 6, [0049]) and determining the braking force to avoid a collision with the obstacle (page 8, [0068]). It would have been obvious to one of ordinary skill in the art, at the time of invention, to determine the time to collision and determine the braking force required to avoid a collision with the obstacle in the system of Hosokawa, as taught by Maruko, in order to properly implement the braking contemplated by Hosokawa.

b. As per claim 12, Maruko teaches determining target acceleration derivative with respect to time (Gx*, page 5, [0039]).

c. As per claim 13, Maruko teaches a relative distance and a time to collision (page 6, [0049]).

d. As per claim 14, Maruko teaches determining the obstacle velocity (page 9, [0072]).

e. As per claim 15, Maruko teaches that the time to collision is determined from the second order factor of relative distance (page 6, [0049]).

f. As per claim 18, Maruko teaches time to collision determination (page 6, [0049]).

g. As per claim 19, Maruko teaches a rate of approach (dL/dt, page 6, [0049]).

h. As per claims 21 and 22, Maruko teaches determining the obstacle processing (page 9, [0072]), which includes factors that are mathematically related through well-known formulae.

6. Claims 16 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Hosokawa and Maruko as applied to claim 11 above, and further in view of Shinmura et al. (US20010003810A1).

a. As per claims 16 and 17, the combination of Hosokawa and Maruko teaches the invention as explained in the rejection of claim 11. The combination does not teach determining and taking into account the bumpiness of the road in determining the braking force. Shinmura teaches a collision avoiding system for vehicles that includes determining and taking into account the bumpiness of the road during the automatic braking to avoid a collision, in order to compensate for the disturbance during braking operation (page 1, [0009]). It would have been obvious to one of ordinary skill in the art, at the time of invention, to determine and take into account the bumpiness of the road in determining the braking force in the system and method of the combination, in order to compensate for the disturbance during braking operation, as taught by Shinmura.

Response to Arguments

7. Applicant's arguments filed 2/28/2005 have been fully considered but they are not persuasive.

a. Specifically, applicant's arguments that Hosokawa does not teach a circumferentially rotating laser are not persuasive. The Examiner believes that Hosokawa does in fact teach that the laser rotates circumferentially in column 10 at lines 62-63. The adjective as used to modify the limitation of "rotating" supports the

reasonable interpretation by the Examiner that the laser rotates in a circle. Hosokawa teaches that the laser rotates 360 degrees in the above cited portion of the reference. This satisfies the limitation that the laser be "circumferentially rotating" as used in the claims.

b. Additionally, as for the applicant's arguments that the type of laser used in Sizer does not satisfy the given specifications, the Examiner again points out that modifications to achieve a given output would be obvious to one of ordinary skill in the art at the time of the invention, especially so when power output and specifications are mandated by the government. Tuning a laser to government required safety levels for use on highways is its own obviousness motivation.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric M Gibson whose telephone number is (571) 272-6960. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas Black can be reached on (571) 272-6956. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

EMG

MICHAEL J. ZANELLI
PRIMARY EXAMINER

Office Action Summary

Application No.	Applicant(s)	
10/613,885	HUANG, BAOJIA	
Examiner	**Art Unit**	
Eric M Gibson	3661	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 July 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-22* is/are pending in the application.

4a) Of the above claim(s)_____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *03 July 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Specification

1. The abstract of the disclosure is objected to because it simply contains a recitation of elements and does not adequately provide a narrative description of the invention. Correction is required. See MPEP § 608.01(b).

Claim Objections

2. Claims 12-22 are objected to because of the following informalities: The preliminary amendment underlines the newly added claims. This is improper format. Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 11-22 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

a. Claim 11 recites the limitation "the obstacle" in lines 5-9. There is insufficient antecedent basis for this limitation in the claim. There is no prior recitation of a single "obstacle" identified; Line 3 of the claim recites, "detecting circumferential obstacles as bodies." It is not clear how the detected circumferential obstacles detected as bodies are related to the later repeated recitation of "the" obstacle.

b. Additionally in claim 11, because there also appears to be a missing essential step in the claim of somehow identifying one of the "circumferential obstacles detected as bodies" as "the obstacle" the claim is indefinite.

c. Claim 12 recites the limitation "an absolute value of da/dt" in line 2. There is insufficient antecedent basis for this limitation in the claim. There is no prior recitation of any means for calculating, determining, or processing any signals to achieve a value of da/dt. It is unknown what the value relates to, what signal or element it represents a "da/dt" value of, or how it is measured in the context of the claim language. For example, da/dt can be a measured quantity of the obstacle or of the vehicle. It is not known which of these two options, or another entirely, the value is supposed to represent.

d. Claim 18 recites the limitation "determining the vertical and horizontal components" in line 2-3. This limitation is indefinite because it does not identify what vertical and horizontal components are being determined.

e. Claim 20 recites the limitation "providing a plurality of channels" in line 2. This limitation is indefinite because it does not identify what the "channels" are in reference to or which element of the claim is being provided with "channels".

f. Claims 13-17, 19, 21, and 22 are necessarily rejected as being dependent upon a rejected base claim.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1-4, 7, and 8 are rejected under 35 U.S.C. 102(b) as being anticipated by Hosokawa et al. (US005864391A).

a. As per claim 1, Hosokawa teaches a vehicle collision avoidance system (figure 18) that includes a rotating pulsed infrared laser beam scanner for generating a signal of an obstacle (210, figure 18), a processing circuit for processing the signal and generating a plurality of signals (220, figure 18), a processor for processing the plurality of signals and generating a braking signal (200, figure 18), and a braking apparatus responsive to the braking signal (241, figure 18).

b. As per claim 2, Hosokawa teaches scanning horizontally and vertically (figure 5).

c. As per claims 3 and 4, the scanner taught by Hosokawa is "operable to" scan an object from 1.6m to 120m, distances relevant in a collision avoidance system.

d. As per claim 7, Hosokawa teaches a vehicle collision avoidance method (figure 19) that includes determining features of an obstacle using a rotating pulsed infrared laser beam scanner (S20, figure 19), processing signals representative of the determined features (S70, figure 19), and braking the vehicle if the proceed signals indicate an imminent collision (S100, figure 19).

e. As per claim 8, Hosokawa teaches scanning horizontally and vertically (figure 5).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 5, 6, 9, and 10 rejected under 35 U.S.C. 103(a) as being unpatentable over Hosokawa in view of Sizer, II (US004737958A).

a. As per claims 5, 6, 9, and 10, Hosokawa teaches the invention as explained in the rejection of claims 1 and 7. Hosokawa does not specify the exact specifications of the laser used in the invention. The use of laser scanners to detect objects in vehicle collision systems is well known in the art. The specific laser used in any application varies depending on the system's requirements. Furthermore, lasers can be tuned to achieve desired specifications, as is well known to one of ordinary skill in the art. One such known laser is the "Nd: YAG" laser, exemplified in the description of Sizer. It would have been obvious to one of ordinary skill in the art, at the time of invention, to include a laser well known in the art and tuned as one of ordinary skill in the art would to achieve desired performance qualities, such as the YAG laser, as exemplified in Sizer.

e. As per claim 15, Maruko teaches that the time to collision is determined from the second order factor of relative distance (page 6, [0049]).

f. As per claim 18, Maruko teaches time to collision determination (page 6, [0049]).

g. As per claim 19, Maruko teaches a rate of approach (dL/dt, page 6, [0049]).

h. As per claim 20, multiple channels are normally employed for use in a photo diode array for detecting the return path of the reflected laser light in the system and method of Hosokawa and Maruko.

i. As per claims 21 and 22, Maruko teaches determining the obstacle processing (page 9, [0072]), which includes factors that are mathematically related through well-known formulae.

7. Claims 16 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Hosokawa and Maruko as applied to claim 11 above, and further in view of Shinmura et al. (US20010003810A1).

a. As per claims 16 and 17, the combination of Hosokawa and Maruko teaches the invention as explained in the rejection of claim 11. The combination does not teach determining and taking into account the bumpiness of the road in determining the braking force. Shinmura teaches a collision avoiding system for vehicles that includes determining and taking into account the bumpiness of the road during the automatic braking to avoid a collision, in order to compensate for the disturbance during braking operation (page 1, [0009]). It would have been obvious to one of ordinary skill

in the art, at the time of invention, to determine and take into account the bumpiness of the road in determining the braking force in the system and method of the combination, in order to compensate for the disturbance during braking operation, as taught by Shinmura.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Breed et al. (US20020198632A1) teaches a method and arrangement for communicating between vehicles. Winner et al. (US006580385B1) teaches an object detection system. Breed et al. (US006370475B1) teaches an accident avoidance system. Sudo et al. (US005714928A) teaches a system for preventing collision for a vehicle. Yoshioka et al. (US005585798A) teaches an obstacle detection system for an automotive vehicle. Shaw et al. (US005529138A) teaches a vehicle collision avoidance system. Wetteborn (US005455669A) teaches a laser range finding apparatus. Shaw et al. (US005314037A) teaches an automobile collision avoidance system. De Saint Blancard et al. (US005296924A) teaches a process for detection of obstacles present, in particular, in front of an automotive vehicle. Chee et al. (US005046184A) teaches a method and apparatus for passive mode locking high power lasers. Hosokawa et al. (DE19713826A1) corresponds to US005864391A.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric M Gibson whose telephone number is (703) 306-4545. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas Black can be reached on (703) 305-8233. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

EMG

MICHAEL J. ZANELLI
PRIMARY EXAMINER

Notice of References Cited

Application/Control No.	Applicant(s)/Patent Under Reexamination	
10/613,885	HUANG, BAOJIA	
Examiner	Art Unit	Page 1 of 2
Eric M Gibson	3661	

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-2002/0198632	12-2002	Breed et al.	701/1
	B	US-2002/0091479	07-2002	Maruko et al.	701/96
	C	US-2001/0003810	06-2001	SHINMURA et al.	701/301
	D	US-6,580,385	06-2003	Winner et al.	342/70
	E	US-6,370,475	04-2002	Breed et al.	701/301
	F	US-5,864,391	01-1999	Hosokawa et al.	356/4.01
	G	US-5,714,928	02-1998	Sudo et al.	340/436
	H	US-5,585,798	12-1996	Yoshioka et al.	342/70
	I	US-5,529,138	06-1996	Shaw et al.	180/169
	J	US-5,455,669	10-1995	Wetteborn, Hainer	356/5.01
	K	US-5,314,037	05-1994	Shaw et al.	180/169
	L	US-5,296,924	03-1994	de Saint Blancard et al.	348/118
	M	US-5,046,184	09-1991	Chee et al.	372/18

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N	DE 19713826 A1	10-1997	Germany	HOSOKAWA et al.	B60K 31/00
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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APPL NO.	FILING OR 371 (c) DATE	ART UNIT	FIL FEE REC'D	ATTY.DOCKET NO	DRAWINGS	TOT CLMS	IND CLMS
10/613,885	07/03/2003	2632	393	AWG 001	9	22	3

CONFIRMATION NO. 6866

FORTUNE LAW GROUP
#315
100 Century Center Ct
San Jose, CA 95112

FILING RECEIPT

OC000000010976086

Date Mailed: 10/03/2003

Receipt is acknowledged of this regular Patent Applicati[illegible] order and you will be notified as to the results of the examination. Be sure to pro[illegible]MBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION whe[illegible]. Fees transmitted by check or draft are subject to collection. Please verify the [illegible] on this receipt. **If an error is noted on this Filing Receipt, please write t[illegible] Examination's Filing Receipt Corrections, facsimile number 703-746-9195. P[illegible] Filing Receipt with the changes noted thereon. If you received a "Notice to Fil[illegible]cation, please submit any corrections to this Filing Receipt with your reply t[illegible]) processes the reply to the Notice, the USPTO will generate another Filing [illegible]uested corrections (if appropriate).**

The application is ready for Examination

Applicant(s)

Baojia Huang, Sunnyvale, CA;

Examiner-
Eric Gibson.
(S 3661 Art unit
(703)306-4545.

Domestic Priority data as claimed by applicant

Foreign Applications

If Required, Foreign Filing License Granted: 09/30/2003

Projected Publication Date: Request for Non-Publication Acknowledged

Non-Publication Request: Yes

Early Publication Request: No

**** SMALL ENTITY ****

Title

Vehicle collision avoidance system and method

Preliminary Class

340

LICENSE FOR FOREIGN FILING UNDER
Title 35, United States Code, Section 184
Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

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PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2003

Application or Docket Number: 10613885

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	22	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	22 minus 20=	* 2
INDEPENDENT CLAIMS	3 minus 3 =	* 0
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☐		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	375	OR	BASIC FEE	770.00
XS 9=	18	OR	XS18=	
X~~43~~=	0	OR	X86=	
+145=	0	OR	+290=	
TOTAL	393	OR	TOTAL	

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
XS 9=		OR	XS18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
XS 9=		OR	XS18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
XS 9=		OR	XS18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
***If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

The following received today:

Preliminary Amendment and check # 2523 in Baojia Huang's patent application ser no. 10/613,885 entitled "Vehicle Collision Avoidance System"

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Baojia Huang	:	Batch No.: None
Serial No. 10/613,885	:	Group Art Unit: 3661
Filed: July 03, 2003	:	Examiner: Eric M. Gibson

For: Vehicle Collision Avoidance System and Method

AMENDMENT AND RESPONSE

Commissioner for Patents
Alexandria, VA

Sir:

In response to the Office Action, dated as mailed on October 20, 2004, please make the below-identified amendments and consider the following remarks:

IN THE SPECIFICATION:

Amend the abstract as follows:

A vehicle collision avoidance system includes a 360 degree circumferentially rotating pulsed infrared laser beam scanner apparatus which rotates in a horizontal plane and a vertical plane simultaneously for generating a first signal representative of an obstacle.[[;]] [[a]] An analog processing circuit is coupled to the circumferentially rotating pulsed infrared laser beam scanner apparatus for processing the first signal and generating a plurality of signals.[[;]] [[a]] A processor is coupled to the processing circuit for processing the plurality of signals and generating a braking signal[[;]] and providing a braking apparatus ~~responsive to~~ with the braking signal. Associated methods are also provided. The system and method of the invention are based on a second order model which characterizes the relationship in both space and time between the vehicle and the obstacle. The circumferentially rotating pulsed infrared laser beam scanner apparatus includes an eye-safe laser apparatus in terms of peak power, pulse width, repetition rate and divergent angle.

IN THE CLAIMS:

1. (Currently Amended) A vehicle collision avoidance system comprising:

a circumferentially rotating pulsed infrared laser beam scanner apparatus including a laser pulsed emitter and an infrared laser sensor for generating a first signal representative of an obstacle scanned, the laser pulsed emitter rotating circumferentially in a horizontal plane and a vertical plan simultaneously, the infrared laser sensor circumferentially rotating synchronously with the laser pulsed emitter in the horizontal plane and receiving a reflected laser beam signal from the obstacle scanned;

a processing circuit coupled to the circumferentially rotating pulsed infrared laser beam scanner apparatus for processing the first signal and generating a plurality of signals;

a processor coupled to the processing circuit for processing the plurality of signals and generating a braking signal; and

a braking apparatus responsive to the braking signal.

2. (Canceled)

3. (Currently Amended) The vehicle collision avoidance system of claim 1, wherein the circumferentially rotating pulsed infrared laser beam scanner apparatus is operable to scan an object from 1.6m to 120m.

4. (Currently Amended) The vehicle collision avoidance system of claim 2, wherein the circumferentially rotating pulsed infrared laser beam scanner apparatus rotates in the horizontal plane at 48 revolutions per second and with a period of 20.83ms and in the vertical plane at 8 sectors per second and a period of 20.83ms.

5. (Currently Amended) The vehicle collision avoidance system of claim 1, wherein the circumferentially rotating pulsed infrared laser beam scanner apparatus emits a laser beam having 28.45W peak power, an average power of 142mW, a wavelength between 1μm [[1um]] and 1.550μm ~~m~~ excluding the region between 1.3μm ~~1.3um~~ and 1.4μm ~~1.4um~~, and preferably between 1.450μm and 1.550μm, a 1.0ns to 1.25ns pulse width, [[and]] a 10Mhz to 110Mhz repetition rate, and a 0.002 radian emitting pulsed laser beam divergent angle.

6. (Canceled)

7. (Currently Amended) A method of avoiding a vehicle collision comprising:

determining features of an obstacle using a circumferentially rotating pulsed infrared laser beam scanner apparatus;

processing signals representative of the determined features; and

braking the vehicle in the event the processed signals indicate an imminent collision.

8. (Currently Amended) The method of avoiding a vehicle collision of claim 7, wherein the circumferentially rotating pulsed infrared laser beam scanner apparatus rotates in a horizontal plane and in a vertical plane simultaneously.

9. (Currently Amended) The method of avoiding a vehicle collision of claim 7, wherein the circumferentially rotating pulsed infrared laser beam scanner apparatus emits a laser beam having 28.45W peak power, an average power of 142mW, a wavelength between 1μm [[1um]] and 1.550μm ~~1.550um~~ excluding the region between 1.3μm [[1.3um]] and 1.4μm [[1.4um]], and preferably between 1.450μm and 1.550μm, a 1.0ns to 1.25ns pulse ~~width, [[and]] 10Mhz to 110Mhz~~ repetition rate, and a 0.002 radian emitting pulsed laser beam divergent angle.

10. (Canceled)

11, (Currently Amended) A method of avoiding a vehicle collision comprising:

circumferentially detecting ~~circumferential obstacles as~~ bodies proximate the vehicle;

obtaining data from a rotating pulsed infrared laser beam scanner apparatus including a time when the beam reaches a first edge of each body ~~the obstacle~~ and a time when the beam reaches a second edge of each body ~~the obstacle~~;

determining a relative distance from the scanner apparatus to each body ~~the obstacle~~;

determining a time to collision with each body ~~the obstacle~~; and

determining a braking force to avoid a collision with each body ~~the obstacle~~.

12. (Currently Amended) ~~The method of avoiding a vehicle collision of claim 11, further comprising determining a critical point at which an absolute value of da/dt approaches zero.~~ The method of avoiding a vehicle collision of claim 11, further comprising determining a critical point at which an absolute value of the derivative of each bodies acceleration with respect to time ~~da/dt~~ approaches zero.

13. (Currently Amended) ~~The method of avoiding a vehicle collision of claim 12, wherein determining the relative distance and determining the time of collision are initiated at the critical point.~~ The method of avoiding a vehicle collision of claim 12, wherein determining the relative distance and determining the time of collision are initiated at the critical point.

14. (Currently Amended) ~~The method of avoiding a vehicle collision of claim 11, further comprising determining a relative angular velocity of the obstacle.~~ The method of avoiding a vehicle collision of claim 11, further comprising determining a relative angular velocity of each body ~~the obstacle~~.

15. (Currently Amended) ~~The method of avoiding a vehicle collision of claim 11, wherein determining the time of collision comprises computing a second order factor.~~ The method of avoiding a vehicle collision of claim 11, wherein determining the time of collision comprises computing a second order factor.

16. (Currently Amended) ~~The method of avoiding a vehicle collision of claim 11, further comprising determining the bumpiness of a road surface.~~ The method of avoiding a vehicle collision of claim 11, further comprising determining the bumpiness of a road surface.

17. (Currently Amended) ~~The method of avoiding a vehicle collision of claim 16, wherein determining the braking force to avoid a collision with the obstacle comprises determining a first braking force in a case where the time of collision is less than 1.5 seconds and a second braking force in a case where the road is bumpy.~~ The method of avoiding a vehicle collision of claim 16, wherein determining the braking force to avoid a collision with each obstacle ~~the obstacle~~ comprises determining a first braking force in a case where the time of collision is less than 1.5 seconds and a second braking force in a case where the road is bumpy.

18. (Currently Amended) ~~The method of avoiding a vehicle collision of claim 11, wherein determining the time of collision further comprises determining~~

~~vertical and horizontal components.~~ The method of avoiding a vehicle collision of claim 11, wherein determining the time of collision further comprises determining vertical and horizontal components of each body.

19 (Currently Amended) ~~The method of avoiding a vehicle collision of claim 11, further comprising determining a rate of approach of the vehicle and the obstacle.~~ The method of avoiding a vehicle collision of claim 11, further comprising determining a rate of approach of the vehicle and each body ~~the obstacle~~.

20. (Canceled)

21. (Currently Amended) ~~The method of avoiding a vehicle collision of claim 11, wherein the obtaining and determining steps are performed in a point to point vector processing manner.~~ The method of avoiding a vehicle collision of claim 11, wherein the obtaining and determining steps are performed in a point to point vector processing manner.

22. (Currently Amended) ~~The method of avoiding a vehicle collision of claim 11, further comprising using an analog circuit to process the time when the beam reaches the first edge of the obstacle and the time when the beam reaches the second edge of the obstacle, the relative distance from the scanner apparatus to the obstacle, a relative angular velocity of the obstacle, an acceleration of the obstacle and a derivative of the acceleration.~~ The method of avoiding a vehicle collision of claim 11, further comprising using an analog circuit to process the time when the beam reaches the first edge of each body ~~the obstacle~~ and the time when the beam reaches the second edge of each body ~~the obstacle~~, the relative distance from the scanner apparatus to each body ~~the obstacle~~, a relative angular velocity of each body ~~the obstacle~~, an acceleration of each body ~~the obstacle~~ and a derivative of the acceleration.

REMARKS

This amendment and response is responsive to the Office Action of October 20, 2004.

The abstract has been objected to because it simply contains a recitation of elements and does not adequately provide a narrative description of the invention.

Claims 12-22 have been objected to because the preliminary amendment underlines the newly added claims.

Claims 11-22 have been rejected under 35 U.S.C. 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 1-4, 7 and 8 have been rejected under 35 U.S.C. 102(b) as being anticipated by Hosokawa et al.

Claims 5, 6, 9 and 10 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Hosokawa et al. in view of Sizer, II. Claims 11-15 and 18-22 have been rejected under the same statutory provision as being unpatentable over Hosokawa et al. in view of Maruko et al. Claims 16 and 17 have been rejected under the same statutory provision as being unpatentable over Hosokawa et al. and Maruko et al. as applied to claim 11 and further in view of Shinmura et al.

By this amendment claims 1-19 and 21-22 have been amended. Claims 2, 6, 10 and 20 have been canceled.

OBJECTIONS TO THE SPECIFICATION

The abstract has been amended to provide a narrative description of the invention.

CLAIM OBJECTIONS

By this amendment, claims 12-19 and 21-22 have been amended to correct the improper format used in the preliminary amendment. Claim 20 has been canceled.

35 U.S.C. 112 REJECTIONS

Claim 11 has been amended to recite a method of avoiding a vehicle collision comprising "circumferentially detecting bodies proximate the vehicle; obtaining data from a rotating pulsed infrared laser beam scanner apparatus including a time when the beam reaches a first edge of each body and a time when the beam reaches a second edge of each body; determining a relative distance from the scanner apparatus to each body; determining a time to collision with each body; and determining a braking force to avoid a collision with each body." Withdrawal of this rejection is respectfully requested.

Claim 12 has been amended to recite the "method of avoiding a vehicle collision of claim 11, further comprising determining a critical point at which an absolute value of the derivative of each bodies acceleration with respect to time approaches zero." Withdrawal of this rejection is respectfully requested.

Claim 18 has been amended to recite the "method of avoiding a vehicle collision of claim 11, wherein determining the time of collision further comprises determining vertical and horizontal components of each body." Withdrawal of this rejection is respectfully requested.

Claim 20 has been canceled.

Applicant submits that claims 13-17, 19, 21 and 22 now depend either directly or indirectly from amended claim 11 which now particularly points out and distinctly claims the subject matter which the applicant regards as the invention. Withdrawal of these rejections is respectfully requested.

35 U.S.C. 102 REJECTIONS

Claims 1-4, 7 and 8 stand rejected under 35 U.S.C. 102(b) as being anticipated by Hosokawa et al. Hosokawa et al. disclose a radar apparatus including a rotary polygon mirror with a plurality of mirror surfaces inclined at different angles. A semiconductor laser diode and a collimator lens are disposed above the polygon mirror. An infrared pulse beam emitted from the semiconductor laser diode is reflected by a reflection mirror disposed at an upper position in from of the polygon mirror to reflect the pulse beam obliquely downward toward the rotary polygon mirror so that the pulse beam is reflected as a transmission beam advancing toward a measuring area in a forward direction. A light receiving means receives the transmission beam returned from an object positioned within the measuring area. As shown in FIG. 5, the scanning area 81 includes an area oriented ahead of the vehicle and the scanning angle is limited to 120 degrees by the use of polygon mirror 31 as shown in FIGS. 11A and 11B.

In contrast, and as claimed in amended independent claim 1, the vehicle collision avoidance system of the present invention comprises "a circumferentially rotating pulsed infrared laser beam scanner apparatus". The claimed system provides detection of obstacles circumferentially of the vehicle in contrast to the Hosakawa et al. apparatus. Withdrawal of this rejection is respectfully requested.

Dependent claims 3-4 depend either directly or indirectly from amended independent claim 1 and include all of the limitations thereof. Withdrawal of this rejection is respectfully requested.

Amended independent claim 7 recites a method of avoiding a vehicle collision comprising "determining features of an obstacle using a circumferentially rotating pulsed infrared laser beam scanner apparatus". For the reasons discussed above, the cited reference does not anticipate the invention as claimed in amended independent claim 7. Withdrawal of this rejection is respectfully requested.

Claim 8 depends from amended independent claim 7 and recites all of the limitations thereof. Withdrawal of this rejection is respectfully requested.

35 U.S.C. 103 REJECTIONS

Claims 5, 6, 9 and 10 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Hosokawa et al. in view of Sizer, II. Sizer, II discloses a Nd: YAG laser for use in a high repetition rate laser source having high power. The Sizer, II Nd: YAG laser is not appropriate for use in a vehicle collision avoidance system as it does not meet maximum permissible exposure limits (MPE). As recited in amended claim 5, the circumferentially rotating pulsed infrared laser beam scanner apparatus emits a laser beam having "a wavelength between 1um and 1.550 um excluding the region between 1.3um and 1.4um". Such a laser is not shown or disclosed by Sizer, II. Additionally, amended claim 5 depends from amended independent claim 1 and includes all of the limitations thereof which are not shown or suggested by the cited references. Withdrawal of this rejection is respectfully requested.

Claim 6 has been canceled.

Claims 11-15 and 18-22 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Hosokawa et al. in view of Maruko et al. Maruko et al. disclose a braking control system with object detection system interaction . A scanning laser radar sensor is used as the object detector 31 to capture, recognize, sense or detect the preceding vehicle (or relevant target vehicle) or a frontally located object, and to monitor a vehicle-to-vehicle distance (or an inter-vehicle distance or a separating distance between the host vehicle and the preceding vehicle) or a relative distance L of the frontally located object (or the preceding vehicle) relative to the host vehicle, and to monitor a relative angle theta of the direction of the preceding vehicle's motion or relative to the object. Thus Maruko et al. do not show or suggest the use of a circumferentially rotating pulsed infrared laser beam scanner as recited in amended independent claim 11. Withdrawal of this rejection is respectfully requested.

Amended claims 12-15 and 18-22 depend either directly or indirectly from amended independent claim 11 and include all of the limitations thereof. For the reasons discussed above, the cited references do not show or suggest the recited features of the present invention. Withdrawal of this rejection is respectfully requested.

Claims 16 and 17 stand rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Hosokawa et al. and Maruko et al. as applied to claim 11 and further in view of Shinmura et al. Shinmura et al. disclose a collision avoiding system for vehicles for enhancing a collision avoiding effect by stabilizing a vehicle behavior during automatic braking. A laser-radar head unit 8 acts as an obstacle detecting means for detecting an obstacle ahead of a vehicle. Thus Shinmura et al. do not show or suggest the use of a circumferentially rotating pulsed infrared laser beam scanner as recited in amended independent claim 11. Amended claims 16 and 17 depend either directly or indirectly from amended independent claim 11 and include all of the limitations thereof. The cited references do not show or suggest the recited

features of the present invention. Withdrawal of this rejection is respectfully requested.

CONCLUSION

All of the claims now remaining in the application are in condition for allowance and an indication to that effect is respectfully requested. The Examiner is invited to contact the undersigned with any questions regarding the present amendment.

Respectfully submitted,

Douglas Mackenzie
Attorney Reg. No. 38,955
Fortune Law Group
100 Century Center Court
Suite 315
San Jose, CA 95112
(408) 436-0789

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on February 22, 2005.

Douglas Mackenzie
Attorney Reg. No. 38,955
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100 Century Center Court
Suite 315
San Jose, CA 95112
(408) 436-0789

The following received today:

Amendment and Response in Ser. No. 10/613,885 filed on 07/03/2003 and Transmittal Form, PTO/SB/22 and PTO-2038.

AWG001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

INVENTOR:	Baojia Huang	:	SERIAL NO.:	10/613,885
FILING DATE:	July 3, 2003	:	GROUP ART UNIT:	Not assigned
EXAMINER:	Not assigned			
FOR:	Vehicle Collision Avoidance System			

PRELIMINARY AMENDMENT

Please enter the following amendments in the above-identified application.

IN THE CLAIMS

Please amend the following claims:

3. (ONCE AMENDED) The vehicle collision avoidance system of claim 1 [2], wherein the rotating pulsed infrared laser beam scanner apparatus is operable to scan an object from 1.6m to 120m.

11, (ONCE AMENDED) A method of avoiding a vehicle collision comprising:

detecting circumferential obstacles as bodies;

obtaining data from a rotating pulsed infrared laser beam scanner apparatus including a time when the beam reaches a first edge of the obstacle and a time when the beam reaches a second edge of the obstacle;

determining a relative distance from the scanner apparatus to the obstacle; [and]

determining a time to collision with the obstacle; and [.]

determining a braking force to avoid a collision with the obstacle.

Please add the following new claims:

12. (NEW) The method of avoiding a vehicle collision of claim 11, further comprising determining a critical point at which an absolute value of da/dt approaches zero.

13. (NEW) The method of avoiding a vehicle collision of claim 12, wherein determining the relative distance and determining the time of collision are initiated at the critical point.

14. (NEW) The method of avoiding a vehicle collision of claim 11, further comprising determining a relative angular velocity of the obstacle.

15. (NEW) The method of avoiding a vehicle collision of claim 11, wherein determining the time of collision comprises computing a second order factor.

16. (NEW) The method of avoiding a vehicle collision of claim 11, further comprising determining the bumpiness of a road surface.

17. (NEW) The method of avoiding a vehicle collision of claim 16, wherein determining the braking force to avoid a collision with the obstacle comprises determining a first braking force in a case where the time of collision is less than 1.5 seconds and a second braking force in a case where the road is bumpy.

18 (NEW) The method of avoiding a vehicle collision of claim 11, wherein determining the time of collision further comprises determining vertical and horizontal components.

19 (NEW) The method of avoiding a vehicle collision of claim 11, further comprising determining a rate of approach of the vehicle and the obstacle.

20. (NEW) The method of avoiding a vehicle collision of claim 11, further comprising providing a plurality of channels having a bandwidth of about 100 kHz.

PTO/SB/35 (05-03)
Approved for use through 4/30/2003. OMB 0651-0031
U.S. Patent and Trademark Office; U. S. DEPARTMENT OF COMMERCE

NONPUBLICATION REQUEST UNDER 35 U.S.C. 122(b)(2)(B)(i)

First Named Inventor	Baoja Huang
Title	Vehicle Collision Avoidance
Attorney Docket Number	AVG 001

I hereby certify that the invention disclosed in the attached application **has not and will not be** the subject of an application filed in another country, or under a multilateral agreement, that requires publication at eighteen months after filing.

I hereby request that the attached application not be published under 35 U.S.C. 122(b).

07/03/2003
Date

Douglas Mackenzie
Signature

408-436-0789
Telephone number

Douglas Mackenzie
Typed or printed name

This request must be signed in compliance with 37 CFR 1.33(b) and submitted with the application **upon filing.**

Applicant may rescind this nonpublication request at any time. If applicant rescinds a request that an application not be published under 35 U.S.C. 122(b), the application will be scheduled for publication at eighteen months from the earliest claimed filing date for which a benefit is claimed.

If applicant subsequently files an application directed to the invention disclosed in the attached application in another country, or under a multilateral international agreement, that requires publication of applications eighteen months after filing, the applicant **must** notify the United States Patent and Trademark Office of such filing within forty-five (45) days after the date of the filing of such foreign or international application. **Failure to do so will result in abandonment of this application (35 U.S.C. 122(b)(2)(B)(iii)).**

PTO/SB/17 (05-03)
Approved for use through 04/30/2003. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

FEE TRANSMITTAL for FY 2003

Effective 01/01/2003. Patent fees are subject to annual revision.

☒ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 375.00

Complete if Known	
Application Number	n/a
Filing Date	07/03/2003
First Named Inventor	Baojia Huang
Examiner Name	n/a
Art Unit	n/a
Attorney Docket No.	AWB 001

METHOD OF PAYMENT *(check all that apply)*

☒ Check ☐ Credit card ☐ Money Order ☐ Other ☐ None

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Deposit Account Name

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☐ Charge fee(s) indicated below ☐ Credit any overpayments

☐ Charge any additional fee(s) during the pendency of this application

☐ Charge fee(s) indicated below, except for the filing fee to the above-identified deposit account.

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1001	750	2001	375	Utility filing fee	375
1002	330	2002	165	Design filing fee	
1003	520	2003	260	Plant filing fee	
1004	750	2004	375	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	

SUBTOTAL (1) ($) 375.00

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

	Extra Claims		Fee from below	Fee Paid
Total Claims	-20** =	X		=
Independent Claims	- 3** =	X		=
Multiple Dependent				=

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	18	2202	9	Claims in excess of 20
1201	84	2201	42	Independent claims in excess of 3
1203	280	2203	140	Multiple dependent claim, if not paid
1204	84	2204	42	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) —

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	
1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for *ex parte* reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
1252	410	2252	205	Extension for reply within second month	
1253	930	2253	465	Extension for reply within third month	
1254	1,450	2254	725	Extension for reply within fourth month	
1255	1,970	2255	985	Extension for reply within fifth month	
1401	320	2401	160	Notice of Appeal	
1402	320	2402	160	Filing a brief in support of an appeal	
1403	280	2403	140	Request for oral hearing	
1451	1,510	1451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1,300	2453	650	Petition to revive - unintentional	
1501	1,300	2501	650	Utility issue fee (or reissue)	
1502	470	2502	235	Design issue fee	
1503	630	2503	315	Plant issue fee	
1460	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	750	2809	375	Filing a submission after final rejection (37 CFR 1.129(a))	
1810	750	2810	375	For each additional invention to be examined (37 CFR 1.129(b))	
1801	750	2801	375	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($) —

SUBMITTED BY

(Complete *(if applicable)*)

Name (Print/Type)		Registration No. (Attorney/Agent)		Telephone	
Signature				Date	

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

PTO/SB/81 (05-03)
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POWER OF ATTORNEY OR AUTHORIZATION OF AGENT

Application Number	n/a
Filing Date	07/03/2003
First Named Inventor	Baojia Huang
Title	Vehicle Collision Avoidance System and Method
Art Unit	n/a
Examiner Name	n/a
Attorney Docket Number	AWG 001

I hereby appoint:

☐ Practitioners at Customer Number

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☒ Practitioner(s) named below:

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JINGMING CAI	44579

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I am the:

☒ Applicant/Inventor.

☐ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96).

SIGNATURE of Applicant or Assignee of Record

Name	Baojia Huang		
Signature	Baojia Huang		
Date	6/23/03	Telephone	(408) 739-1888

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☒ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.31 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/SB/01 (10-01)
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DECLARATION — Utility or Design Patent Application

Direct all correspondence to: ☐ Customer Number or Bar Code Label [ ] OR [X] Correspondence address below

Name: Fortune Law Group LLP

Address: 100 Century Center Court, Suite 315

City: San Jose | State: CA | ZIP: 95112

Country: USA | Telephone: (408) 436-0789 | Fax: (408) 436-0758

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

NAME OF SOLE OR FIRST INVENTOR : ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any]): Baojia | Family Name or Surname: Huang

Inventor's Signature: X Baojia Huang | Date: 6/20/03

Residence: City: Sunnyvale | State: CA | Country: USA | Citizenship: USA

Mailing Address: 1352 Kingfisher Way

City: Sunnyvale | State: CA | ZIP: 94087 | Country: USA

NAME OF SECOND INVENTOR: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any]) | Family Name or Surname

Inventor's Signature: X | Date

Residence: City | State | Country | Citizenship

Mailing Address

City | State | ZIP | Country

☐ Additional inventors are being named on the ____supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.

PTO/SB/01 (10-01)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☐ Declaration Submitted with Initial Filing OR ☒ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	AWG 001
First Named Inventor	Baojia Huang
COMPLETE IF KNOWN	
Application Number	n / a
Filing Date	07/03/2003
Art Unit	not assigned
Examiner Name	not assigned

As the below named inventor, I hereby declare that:

My residence, mailing address, and citizenship are as stated below next to my name.

I believe I am the original and first inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Vehicle Collision Avoidance System and Method

(Title of the Invention)

the specification of which

☒ is attached hereto

OR

☐ was filed on (MM/DD/YYYY) _____ as United States Application Number or PCT International Application Number _____ and was amended on (MM/DD/YYYY) _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

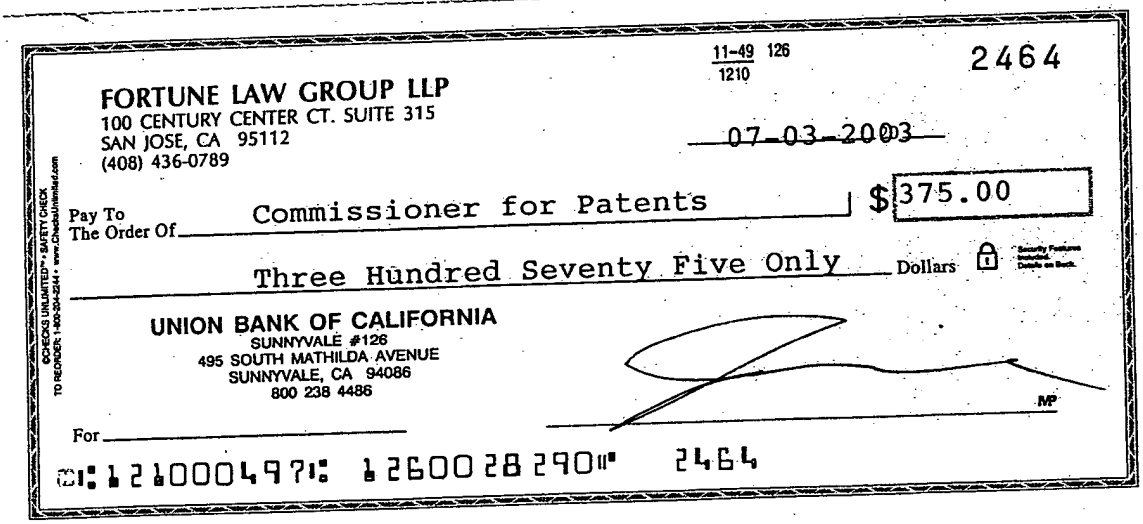
I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent, inventor's or plant breeder's rights certificate(s), or any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
none			☐	☐	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

Following received today:

Utility patent application of Baojia Huang entitled "Vehicle Collision Avoidance System and Method" including 28 pages specification and claims, 9 pages drawings, Forms PTO/SB/05, PTO/SB/35, PTO/SB/17, PTO/SB/81, PTO/SB/01 and check #2464.



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PTO/SB/05 (06-03)
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U.S. Patent and Trademark Office. U.S. DEPARTMENT OF COMMERCE

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	AWG 001
First Inventor	Buojia Huang
Title	Vehicle collision ...
Express Mail Label No.	EU 392284281 US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Commissioner for Patents, P.O. Box 1450, Alexandria VA 22313-1450

1. [X] Fee Transmittal Form (e.g., PTO/SB/17) *(Submit an original and a duplicate for fee processing)*
2. [X] Applicant claims small entity status. See 37 CFR 1.27.
3. [X] Specification [*Total Pages* 28] *(preferred arrangement set forth below)*
   - Descriptive title of the invention
   - Cross Reference to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to sequence listing, a table, or a computer program listing appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings *(if filed)*
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
4. [X] Drawing(s) (*35 U.S.C. 113*) [*Total Sheets* 9]
5. Oath or Declaration [*Total Sheets* _____]
   a. [X] Newly executed (original or copy)
   b. [ ] Copy from a prior application (37 CFR 1.63(d)) *(for continuation/divisional with Box 18 completed)*
      i. [ ] DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) name in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
6. [ ] Application Data Sheet. See 37 CFR 1.76
7. [ ] CD-ROM or CD-R in duplicate, large table or Computer Program *(Appendix)*
8. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   a. [ ] Computer Reader Form (CRF)
   b. Specification Sequence Listing on:
      i. [ ] CD-ROM or CD-R (2 copies); or
      ii. [ ] Paper
   c. [ ] Statements verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

9. [ ] Assignment Papers (cover sheet & document(s))
10. [ ] 37 CFR 3.73(b) Statement [ ] Power of Attorney *(when there is an assignee)*
11. [ ] English Translation Document *(if applicable)*
12. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations
13. [ ] Preliminary Amendment
14. [X] Return Receipt Postcard (MPEP 503) *(Should be specifically itemized)*
15. [ ] Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
16. [X] Nonpublication Request under 35 U.S.C. 122 (b)(2)(B)(i). Applicant must attach form PTO/SB/35 or its equivalent.
17. [ ] Other: .....

18. If a CONTINUING APPLICATION, *check appropriate box, and supply the requisite information below and in the first sentence of the specification following the title, or in an Application Data Sheet under 37 CFR 1.76:*

[ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No.: .....

Prior application information: *Examiner* _____ *Art Unit:* _____

For CONTINUATION OF DIVISIONAL APPS only; The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 5b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

19. CORRESPONDENCE ADDRESS

[ ] Customer Number: _____ OR [ ] Correspondence address below

Name	FORTUNE LAW GROUP				
Address	100 century Center Ct #315				
City	San Jose	*State*	CA	*Zip Code*	95112
Country	USA	*Telephone*	408-436-0789	*Fax*	408-436-0758

Name (Print/Type)	Douglas Mackenzie	*Registration No. (Attorney/Agent)*	38,955
Signature	Douglas Mackenzie	*Date*	07/03/2003

the following received today:

Utility patent application of Baojia Huang entitled "vehicle collision Avoidance System and Method" including 26 pages specification and claims, 9 pages drawings, Forms PTO/SB/05, PTO/SB/35, PTO/SB/17, PTO/SB/81, PTO/SB/01 and check #2464.

PTO/SB/92 (05-03)
Approved for use through 04/30/2003. OMB 0561-0031
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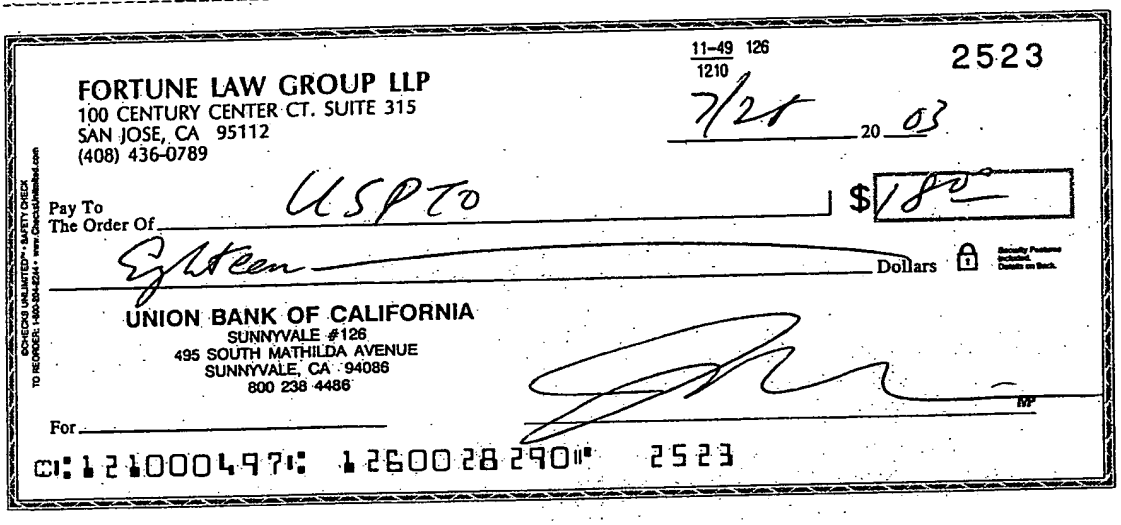
The following received today:

Preliminary Amendment and check # 2523 in Baoqia Huang's patent application ser no. 10/613,685 entitled "Vehicle Collision Avoidance System"



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⑆121000497⑆ 126002829011 2523

VEHICLE COLLISION AVOIDANCE SYSTEM AND METHOD

BACKGROUND OF THE INVENTION

[001] The present invention generally relates to vehicle collision avoidance systems and methods and more particularly to a vehicle collision avoidance system and method employing a rotating pulsed infrared laser beam scanner apparatus for detecting obstacles circumferentially of the vehicle.

[002] Vehicle collision avoidance systems and methods are well known in the art. For example, U.S. Patent No. 4,825,211, "Warning Device for Vehicles Against an Approaching Objects" discloses a warning device for use on a vehicle for sensing an approaching object when the vehicle is moving backwards. The device produces a first signal when the object is in remote proximity of the vehicle and at least a second signal when the object is in close proximity of the vehicle.

[003] U.S. Patent No. 4,872,051, "Collision Avoidance Alarm System" discloses a passive collision avoidance system. An optical sensor is disposed to provide a continuous raster scan of the scene within a wide angle of the direction of travel of the vehicle. This sensor output is converted into digital data and stored. A computer system compares consecutive scenes to detect identifiable objects. For such identifiable objects, the computer calculates the centroid of the object and its angle, and a measure of the size or extent of the object. Detection of an object having a constant angle and an increasing measure of extent causes an alarm to be triggered.

[004] U.S. Patent No. 5,314,037 "Automobile Collision Avoidance System" discloses a system based on laser radars for aiding in avoidance of automobile collisions. The system includes laser radars with transmitters and receivers, a computer, a warning device and an optional automatic braking device. The system compares a predicted collision time with a minimal allowable time to determine the immanency of a collision. When the system determines that a situation likely to result in an accident exists, it provides a warning. The optional automatic braking device is used when the vehicle user fails to respond to the warning.

[005] U.S. Patent No. 5,410,304 "Method and Apparatus for Displaying the Impending Danger Due to Speed Associated with the Driving Situation of a Vehicle" discloses a method in accordance with which a degree of danger is defined and calculated

and displayed to the driver of a vehicle, the degrees of danger indicating whether the driver of the vehicle is driving too close to a vehicle in front or other obstacle or is driving too fast in a fog. The signals necessary for this purpose are obtained from vehicle environment sensors, for example from a distance warning radar or distance recording radar and an infrared visual range measuring system, and are analyzed, together with vehicle condition signals, by a safety computer. On the basis of its specific programming, the computer determines, for the respective current driving condition, which of two degrees of danger is instantaneously predominant and indicates the condition which is respectively more critical to safety on a display.

[006] U.S. Patent No. 5,463,384 "Collision Avoidance System for Vehicles" discloses a system including an object detection module mounted on a vehicle for detecting the presence of an object within a monitored zone of space adjacent the vehicle. The detection unit emits a plurality of beams of infrared energy and detects the reflection of such energy from objects within the zone. The detection module is typically activated by the host vehicle's electrical turn signal. The detection module includes a plurality of associated pairs of light emitting diodes and photosensitive detectors for sensing the reflected light.

[007] U.S. Patent No. 5,646,612 "Method for Avoiding Collision of Vehicle and Apparatus for Performing the Same" discloses an apparatus which determines a kind of an object ahead of a vehicle to warn a driver based on the kind of the object and properly performs deceleration and braking operations based on a position of the object and a speed of the vehicle.

[008] U.S. Patent No. 6,012,008 "Method and Apparatus for Predicting a Crash and Reacting Thereto" discloses an apparatus which is mounted on a vehicle and determines the time-to-impact for approaching obstacles that are within a limited distance from the host vehicle. The system can be deployed in the front of the host vehicle for warning of frontal impact, and at the sides for warning of side impact.

[009] U.S. Patent No. 6,470,273 "Collision Warning System" discloses a system including pairs of optical sensors integral to a moving vehicle. Each of the optical sensors of the pairs of said sensors is enabled for the detection of visible light magnitudes and infrared light magnitudes in the external vicinity of the vehicle, and for creating corresponding electrical signals. The optical sensors are directed in a physically spaced apart manner along a line of travel of the vehicle. Temporal changes in the magnitudes of

the electrical signals and a probability of a collision with an object external to the vehicle are determined and a warning signal is generated when collision is possible.

[010] As can be seen, the prior art discloses systems and methods for sensing objects and potential collisions within narrow ranges, generally in the direction of vehicle travel or to cover "blind spots", and as such there is a need for a vehicle collision avoidance system and method employing a rotating pulsed infrared laser beam scanner apparatus for detecting obstacles circumferentially of the vehicle.

SUMMARY OF THE INVENTION

[011] In accordance with one aspect of the invention, a vehicle collision avoidance system includes a rotating pulsed infrared laser beam scanner apparatus for generating a first signal representative of an obstacle; a processing circuit coupled to the rotating pulsed infrared laser beam scanner apparatus for processing the first signal and generating a plurality of signals; a processor coupled to the processing circuit for processing the plurality of signals and generating a braking signal; and a braking apparatus responsive to the braking signal.

[012] In accordance with another aspect of the invention, a method of avoiding a vehicle collision includes determining features of an obstacle using a rotating pulsed infrared laser beam scanner apparatus; processing signals representative of the determined features; and braking the vehicle in the event the processed signals indicate an imminent collision.

[013] These and other features, aspects and advantages of the present invention will become better understood with reference to the following drawings, description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[014] FIG. 1 is an isometric view of a vehicle having mounted thereon a rotating pulsed infrared laser beam scanner apparatus in accordance with the present invention;

[015] FIG. 2 is a schematic view showing a sector in accordance with the present invention;

[016] FIG. 2A is a schematic view of an infrared laser beam in accordance with the present invention;

[017] FIG. 3 is a block diagram of a method of avoiding vehicle collisions in accordance with the present invention;

[018] FIG. 4 is a circuit diagram of a an analog circuit in accordance with the present invention;

[019] FIG. 5 is a listing showing an algorithm in accordance with the present invention;

[020] FIG. 6 is a schematic diagram of a coordinate system in accordance with the present invention;

[021] FIG. 7 is a schematic diagram of a coordinate system in accordance with the present invention; and

[022] FIG. 8 is a schematic diagram of a coordinate system in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[023] The following detailed description is of the best modes of carrying out the invention. The description is not to be taken in a limiting sense, but is made merely for the purpose of illustrating the general principles of the invention, since the scope of the invention is best defined by the appended claims.

[024] The present invention generally provides a vehicle collision avoidance system and method employing a rotating pulsed infrared laser beam scanner apparatus for detecting obstacles circumferentially of the vehicle.

[025] With reference to FIG. 1, a system in accordance with the invention includes a rotating pulsed infrared laser beam scanner apparatus 100 mounted on a top 110 of a vehicle 120 for transmitting and receiving an infrared laser beam having properties as further described in Table 1. Advantageously, the rotating scanner apparatus 100 includes both horizontal and vertical scanning capabilities. More specifically, the rotating scanner apparatus 100 rotates in a horizontal plane at 48 revolutions per second and in a vertical plane at 8 sectors per second. A sector 200 is shown in FIG. 2 and may include an angle α of 2.5 degrees with the sectors ranging from 28.8 degrees to 88.8 degrees.

$$= \eta rf * [(st'/st) * (sl/sr)] \quad (1)$$

$$= 0.25 * [(\pi Rt'^2/\pi Rt^2)*(\pi Rl^2/2\pi R^2)] \quad (2)$$

$$= [(Dt'^2/Dt^2)*(Dl^2/(Dr)^2] * 0.25 * 1/2 \quad (3)$$

$$= .125\ [(Dl/Dr)]^{**}2 \quad (4)$$

$$= .125\ ((5/18)\ (18 / 18, 000))^{**}2 \quad (5)$$

$$= 9.65Exp(-9) \quad (6)$$

$$Pt \cdot \eta_T = P_{RE} \quad (7)$$

$$Pt \geq 10^{-9}\ W \quad (8)$$

$$Pt_{(peak)} \geq 10^{-9}/9.65Exp(-9) \quad (9)$$

$$= 0.104\ W \quad (10)$$

$$= 104\ mw \quad (11)$$

where ηrf: is the reflection rate – the ratio of reflected power (or energy) over insertion power (or energy), Rt is the area on the target intercept with the laser beam, Rt' is the minimum detectable as design required on the object, and R is the distance to an object 130 (FIG. 1) from the rotating pulsed infrared laser beam scanner apparatus 100. Considering modulation factor 1/100 (carrier purpose) & 0.5 (for ranging purpose, it becomes

$$Pt\ (Average) = 104/200 \quad (12)$$

$$= 0.520\ mW \quad (13).$$

[027] To have 40db (100times of power factor) reserved power capacity to cope with foggy/rainy or dirty targets, it may be necessary to raise the transmitted power potential into a maximum value

$$Pt\ (Max) = 0.104 * 100 \quad (14)$$

$$= 10.4\ W \quad (15)$$

$$Pt\ (max, Average) = .52 * 100 \quad (16)$$

$$= 52\ mw \quad (17).$$

Power of average level, at the cornea after counting the duration when the cornea truly receives the laser beam may be calculated as

$$P(\text{RE, average, cornea}) = Prac \quad (18)$$

$$= 52\ mw*R*\theta/2Pi*R \quad (19)$$

$$= 52*0.002/2Pi \quad (20)$$

$$= 52/3125 \quad (21)$$

$$= 0.0166(mw) \quad (22)$$

where P_{RE} is the receiving power on the sensor and P_t is the transmitting power from transmitter.

[028] From the above computations several conclusions can be obtained. A first conclusion is that the ideal peak transmit power Pt (peak, Res) of the pulsed laser able to deal with reserved potential for a worst condition, may at least be 12.2 W or P (peak, Res) ≥ 10.4 w. A second conclusion is that the basic power requirement (without reserved capacity) may be Pt (peak, basic) = 104 mw. A third conclusion is that the average maximum received power (counting in the object occupation at the circumference factor) may be Pre (AVE) = 0.0166 mw. Finally, a fourth conclusion is that the power density on the cornea may be Pre (density) = Pt (AVE)*S(cornea)/S(target))/S(cornea)

$$= Prac / S(\text{target}) \quad (23)$$

$$=0.0166mw/Pi * Rt**2 \quad (24)$$

$$= 0.0166mw /3.14 *(Rt(min) * 0.0002)**2 \quad (25)$$

$$= 0.0166mw/3.14 (50*0.002)**2 \quad (26)$$

$$= 0.0166mw/0.0314Sqcm \quad (27)$$

$$= 0.530\ mw/Sqcm \quad (28)$$

where St is an area on the target - a cross section formed at certain distance away from the laser source where the propagating laser beam is cut by the target body, Rt is the distance from the laser source to the surface denoted as St, Rt (min) is the minimum distance of Rt determined by the real situation, here taken to be 50cm for safety purposes.

[029] To determine if the pulsed laser beam of the invention is safe in its application in terms OF IEC regulations, the following three computations can be performed. (1) MPE

(single) requirement: Compute the MPE for a single pulse at wave length of 1030 – 1050nm, 1ns to 100ns (Exp(-9)s to Exp(-7)s pulse width range with pulse duration shorter than 1ms yielding EMP (Single) = 5Exp(-3) C4C6J/sqm = 0.005x5x1.33/10,000 = 3.3Exp (-6) J/sq cm. (2) Since the pulsed laser series is designed to be uniform, thus it meets the item B requirement – limited in table 6 and 8 on the IEC60825-1. (3) Find total MPE(train) within the duration for which the concerned target(s) are exposed under the pulsed laser beam. (Average exposure in the train can not possess more energy that if it exists as a single pulse as). Since T = .002/200*2Pi = 1.6Exp(-6) then F = Exp7, N = F (carrier, mod) * T(total) = 1.1 Exp8 *1.6Exp (-6) = 176. Hence MPE (train) = MPEs N **(-0.25) = 3.3Exp(-6) * 176**(-.25) = 3.3 Exp(-6) * 0.275 = 0.906 Exp (-6)J/sqcm. This is the maximum power limit for any pulse in the pulse train. Now compute the max transmitting peak power allowed: MPE(s)/A = Pt * Tp where Tp is the pulse width of the laser pulse series and Tp = Exp(-9)s, Pt (peak, max) = A*MPE(s)/Tp =0.0314 sqcm*0.906Exp (-6) / Exp(-9) = 28.448 W (safety required). Therefore Pt (peak, max) = 28.448W. According to items (1), (2) and (3) above, the infrared pulsed laser of the invention, featuring 9W peak power, 1.03-1.06um wavelength and 0.002rad transmitting angle, dual modulating and dual plane rotating, fully satisfies and complies with IEC 60825 product safety requirements. As the power specified above is for a 700 to 1050 nm laser beam, for higher ranges, the peak power permitted is larger. In considering both factors regarding system sensitivity and water media absorption, the wavelength range may be selected in the region from 1,000nm to 1,550 nm. The allocation of the wavelength may be based on a few factors, including the availability of the component resource. Generally, the region from about 1,300nm to 1,400nm may be excluded to avoid energy loss of the laser beam due to moisture absorption in its propagating path. The power requirements are summarized in Table 2.

Power Type	Scanning Laser Power			
	System needs		Adapted Design	*IEC 60825 Limit*
	Minimum (basic) Requirement	With Reserved Capacity (40dB Reserved)	*As high as what system requires*	*Maximum*
Peak Value	.104W	10.4 W	15 W	*>28.45 W*
Average Value	.52 mW	52 mW	75 mW	*>142 mW*
Wave Main Properties	Best Selected Wavelength: 1450 to 1550nm (IEC 60825 table under Corresponding Frequency Range) Repetition Rate: 10Mhz to 110Mhz (Exp7 Hz to 1.1Exp8 Hz) *Pulse Width: 1.0 – 1.25 ns (constant)*			

Table 2 Power Requirements

[030] With reference to FIG. 3, a method generally designated 300 of avoiding a vehicle collision is shown including a step 310 of transmitting and receiving an infrared laser beam using the rotating pulsed infrared laser beam scanner apparatus 100 described herein. A reflected laser beam is filtered in a step 320 and processed in a step 330. Analog signal processing is achieved using application firmware. In a step 340 the processed analog signal is converted to a digital signal and processed by a digital processor in a step 350 and a co-processor in a step 360. An output signal from the digital

processor is amplified by a power amplifier in a step 370 and input to an electro-hydroid braking control in a step 380. An output signal from the digital processor is also input to a video interface in a step 390 and an output of the video interface is input to a display in a step 395. By operation of the method 300, a vehicle collision is avoided by applying a braking force to the vehicle in step 380 under conditions as further described herein.

[031] FIG. 4 shows an analog circuit generally designated 400 for determining R, R'(t) and R"(t) corresponding to step 330. Using the circuit 400, R is taken at the output of op amp 430 (Vg), R'(t) is taken at the output of op amp 410 (Vd), and R"(t) is taken at the output of op amp 420 (Vf).

[032] To avoid interference, a channel scrambler is provided. Each vehicle is allowed to transmit and receive its own channel separated by a channel band-width of 100 kHz to avoid interference from signals produced by other vehicles using the system and method of the invention. A conventional channel dividing method may be employed to achieve this result as outlined in Table 3. One thousand channels may be used by following the following analysis. In US the total number of vehicles is assumed to be 50 million and among these, 10 million use the system and method of the invention. Hence the maximum number of vehicles in an area subject to mutual interference is 1000. So the system concentration over the total vehicle population in the US is 1/5 and the channel concentration over the system is 1/1000. As the result, the channel concentration over the entire population of vehicles is 1/5 * 1/1000 or 1/5000. Then for a region having 1000 vehicles, the number of these vehicles sharing the same channel is 500 * 1/5000 or 0.1 vehicles. As two vehicles are required to cause a mutual disturbance, 2/0.1 or 20 is the safety factor.

Channel Number	N = 1,000		
Bank Width	B = 100Khz = 0.1Mhz	Filter Type	Frequency Division
Repetition Range***	F (L) = 10Mhz, F (H) = 110Mhz	Resonant Q Value	***

Table 3 Channel Scrambler Design

[033] FIG. 5 shows an algorithm generally designated 500 implementable in the digital processor to achieve the purposes of the invention. In a step 510 Vf is computed as shown and t1 is recorded. In a step 520 Vr is recorded. Then in a step 530 when Vf is

equal to zero a timer is stopped and t2 recorded. In a step 540 Ts is determined as (t2 – t1). In a step 550 Q is determined as shown. Then in a step 555 Tc, the time to collision is determined as Tc = R/Vr. In a step 560 criteria are set as shown. Finally in a step 570 a determination is made if a collision will occur or not.

[034] In order to determine the signal processing time, assume the scanner system has 200 revolution/s in the horizontal direction, and the laser beam sweeps over maximum (full condition) 3000 obstacle bodies during each revolution, that is

$$NOB\ (max) = 200\ Pi/.002$$
$$= 3{,}000.$$

Since detecting one obstacle body consumes 116ns, then the time needed to process data for one revolution is

$$T\ (1Rev.) = PTP(S) * NOB(max) \quad (29)$$
$$= 127\ ns * 3000 \quad (30)$$
$$= .381\ Exp\ 6(ns) \quad (31)$$
$$= 381\ (uS) \quad (32)$$
$$= 0.381\ (ms) \quad (33)$$

The time necessary for processing data obtained within one second's scanning

$$T\ (1s) = 0.381\ ms * 200 \quad (34)$$
$$= 76.2ms \quad (35)$$
$$= 0.076\ S \quad (36)$$

which means there is sufficient time to process all the data, or the data processing speed is fast enough to meet the system requirements. The operating times are summarized in Table 4.

[035] The system overall properties are summarized in Table 5.

Table 4

Signal Process Algorithm & Operating Time

(One "Obstacle Body")

	Object	Formula	Sampling	Analog Process	A/D	Data Fetch	Computing Or Logic		REG	Sub-total (ns)
							Short	Mul.		
Distance Related	Ri	1.5 / Sin αhi	1	5	2	1	0	4	1	14
	Vi	dRc / dt	0	1	2	1	0	0	1	5
	I	Vi < 0 I = 1 Vi > 0 I = 0	0	0	0	1	1	0	1	3
	a	dv /dt	0	1	2	0	0	0	1	4
	a'	da/dt	0	1	2	0	0	0	1	4
	ρ	|a' | - 20 m/s³	0	0	0	2	1	0	1	4
	M	ρ > 0 M = 1 ρ < 0 M = 0	0	0	0	1	1	0	1	3
										37
Angle Related	ωb'	Ts – 1.592Exp (-6)	2	1	2	2	1	0	1	9
	β	d ωb' / dt	0	1	1	0	0	1	1	4
	N	β < 0 N = 1 β > 0 N = 0	0	0	0	1	1	0	1	3
										16
Time Related	T_i	t 2 – t 1	2	1	2	2	1	0	1	9
	T_ω	ωb' / β	0	0	0	2	0	4	1	7
	T_ω Y 1.5	σ = T_ω – 1.5	0	0	0	1	1	0	1	3
	o	σ < 0 O = 1 σ > 0 O = 0	0	0	0	1	1	0	1	3
	T r i	((V**2 – 2Ri * a)**1/2 – V))/ a	0	0	0	5	2	5 * 4 = 20	1	28
	γ	γ = Tri – 1.5	0	0	0	1	1	0	1	3
	L	γ < 0 L = 1 γ > 0 L = 0	0	0	0	1	1	0	1	3
										56
Decision	C	C = M N O L I	0	0	0	5	1	0	1	7
Process Time (Single Obstacle Body)	PTP (S)									116

System Properties		QTT Value	System Properties	QTT	
				Value	Remarks
Electrical Signal Process time.	Analog	<0.1ms	Ranging Distance R	R = 90 m	S < 1,017cmSq.. (Equivalent to: A circle with R = 18cm Or A standing pole with two inches width and 2meters height)
	Digital	<1ms		90m < R < 120m	S = 1,017sqcm
	Total	<1.1ms		General R> 120m	S = S0 (R/R0)**0.5
Mechanical Response Required		T m < 16 ms	Shortest Detecting distance	1.62 m	Remark: S stands for the area where the scanning laser beam strikes on while R0 = 90m S0 = 300sqcm
			Detecting Plane Angle	360°	
Optical Signal Propagating Time		Td < 0.0006 ms	Impact Sustaining In Vertical Axis	10g*	
Obstacle Tracking Period		Horizontal: 21ms Longitudinal: 126ms	Humidity	40%*	
Total Control Time		Between 38 to 143ms	Detecting Height	0.2 – 1.6 m	

Table 5 System Overall Properties

[036] What follows is a discussion of collision criteria. As shown in FIG. 6, two vehicles (Vehicle A and vehicle B) are apart a distance r and travel in the direction with the speeds shown. For the convenience of analysis, we assume that both vehicles are placed in an absolute angular co-ordinate system – the earth ground, and also the relative system with respect to Vehicle A as the original point of the relative system. Both systems use AC as the positive velocity direction and the clockwise direction as the positive angle and angular velocity direction. Vectors denoted with (') represent the relative system, whereas no (') denotes vectors in the absolute system.

[037] Obviously, the projecting image component of relative angular velocity of Vehicle B along vehicle A's direction axis must be zero, otherwise it will not result in collision with Vehicle A, that is

$$Vbt' \cos \gamma = 0 \qquad (37)$$

(in the relative system)

While in the absolute system, it means

$$Vbt \cos \gamma = V \qquad (38)$$

According to movement studies,

$$Vbt = Va + Vbt' \qquad (39)$$

From equation (37), we have either

$$\gamma = 90\ ^\circ \qquad (40)$$

or

$$Vbt' = 0. \qquad (41)$$

[038] The condition where $\gamma = 90\ ^\circ$ is hard to detect, but to detect Vp" and determine that if then Vbt' = 0 is possible. From Equation (39), Vbt' = Vbt-Va. Based on Equation (41) and (39), Vbt' = Vpt – Va = 0 and thus Vbt =Va.

[039] If conditions

$$Vbt = Va \quad (42)$$

and

$$dR / dt = - K < 0, \quad (43)$$

are both true, said two vehicles will result in a collision, that is, it will take the same time – t seconds, for Vehicle A to move through segment AC, for vehicle B to move through BC, and for relative distance between Vehicle A and Vehicle B to become zero. In the mean time, all AC, BC and AB = r will be on the same triangle, upon applying equations (42) and (43).

[040] The mathematical statements below prove that if these two vehicles start from A and B points, after same time t, they move over distance AC and BC upon which AC, BC and r will be able to construct an exact triangle, in other words, they meet at the same time and the same location and a collision occurs. By inspecting triangle ABC, we have

$$AC = Va^* t \quad (44)$$

$$AB = d \quad (45)$$

The triangle hence should meet:

$$BC = (Vat^2 + R^2 - 2\, Vat^* R^* \cos\theta)\ ½ \quad (46)$$

$$\text{but } t = R/ |dr/dt| = R / k \ \ldots\ldots\ldots\ldots \quad (47)$$

$$\text{and } Vb^2 = K^2 + Va^2 - 2Kva \cos\theta \quad (48)$$

(where Vb stands for the absolute velocity of Vehicle B)

That is

$$Vb = (K^2 + Va^2 - 2K\, Va \cos\theta)^{½} \quad (49)$$

The time for vehicle B to travel to C will be

$$T1 = BC/ Vb = \quad (50)$$

$$\frac{(Vat)^2 + R^2 - 2\, Vat^* R^* \cos\theta)^{½}}{(K^2 + Va^2 - 2K\, Va \cos\theta)^{½}}$$

The time for the distance between Vehicle A and B to become zero should be, according to Vr = dr/dt

$$T2 = R / |Vr| = R / K \qquad (51)$$

Since when the time collision to occurs,

$T1 = T2 = t$, hence $R / K =$

$$\frac{(Vat^2 + R^2 - 2\,Va * t * R * \cos\theta)\,½}{(K^2+Va^2 -2K\,Va\cos\theta)½}$$

$$r^2 / K^2 =$$

$$\frac{Va^2*r^2/K^2 + r^2 - 2\,Va*\, r/K*r*\cos\theta}{K^2 + Va^2 - 2\,K\,Va\cos\theta}$$

Crossing multiplying both sides of this equation and then simplifying it to find that

Left side = Right side

$= r^2 K^2 + r^2 va^2 - 2\,Kr^2 Va\cos\theta$

This means the equation is true.

[041] That $Vbt' = 0$ implies that

$R * \omega b' = Vbt' = 0$. Since R can not be zero requires that ω has to be zero, thus we withdraw the criteria to determine if a collision between two vehicles' defined above should occur at:

$$\omega b' = 0 \qquad (52)$$

The relative angular velocity is zero or

$\alpha = Ts * \omega sc$ and

$$dR/dt = Vr < 0 \qquad (53)$$

And the condition when the braking action to be needed is:

$$|Tr| \leq 1.5\ (s) \qquad (54)$$

[042] With reference to FIGS. 7 and 8 $\omega b'$ is defined as the relative angular velocity, from Vehicle A to the dot pointed by the laser beam vector

striking on Vehicle B, turning around Vehicle A clock wisely, ωb is defined as angular velocity, from Vehicle A to the dot pointed by the laser beam vector striking on Vehicle B, turning around Vehicle A clock wisely, ωsc is defined as the angular velocity of the Infrared Laser Scanner, Vb is defined as the velocity of the scanned obstacle, Vs is defined as the line velocity of the scanning beam at the scanned point on the obstacle, A is defined as the diverging angle of the scanning inferred laser beam, Ls is defined as the length the beam vector sweeps over, and Ts is defined as the period for the entire laser beam pass over the extreme point, during which the changing rate of the relative distance maintains zero, mathematically expressed as "dR / dt = 0".

[043] Let Vbp and Vsp stand for Vb's and Vs's projection along Va's direction line MN respectively. Then

$$Ls = R * \alpha$$

$$(V\,bT + \omega sc * R - Va\,Cos\gamma) = R * \alpha \qquad (55)$$

Since

$$Cos\gamma = Cos\,(90-(180-\theta))$$

$$= Cos\,(-90+\theta) = Cos\,(90-\theta)$$

$$= Sin\,\theta$$

Hence equation (55) becomes

$$(V\,bt + \omega sc\,R - Va\,Sin\,\theta)Ts = R * \alpha \qquad (56)$$

and

$$Vbt = R * \alpha / Ts - \omega sc\,R + Va\,Sin\,\theta.$$

And because

$$Vbt' = Vbt - Va\,Sin\,\theta$$ It yields

$$Vbt' = R * \alpha / Ts - \omega sc * R \qquad (57)$$

$$\omega b' * R = Vb'R = Vbt'\,R$$

$\omega b' = Vbt'/R = (R * \alpha / Ts - \omega sc\ R) / R$

$$\omega b' = \alpha / Ts - \omega sc \qquad (58)$$

When $\omega b' = 0$

$$\alpha / Ts - \omega sc = 0$$

That is $\alpha / Ts = \omega sc$

$$\alpha = Ts * \omega sc \qquad (59)$$

[044] In order to determine the collision criteria ωh must be computed. The value ωh stands for the relative horizontal component of the angular velocity defined in equation (58), and it relates to the longitudinal component and the resultant component ω T by

$$\omega T^2 = \omega h^2 + \omega L^2$$

which can be expressed as

$$\omega h = (\omega T^2 - \omega L^2)^{**1/2} \qquad (60)$$

[045] Since the period Tl must ideally be greater than Th to avoid a permanent dead corner in the obstacle detecting process, as well as reducing the error caused by inducing ωL in the calculations, we let

$$TL = 10\ Th.$$

Because the longitudinal angle is $\pi/6$, we have

$$\pi/6\ /\omega L = 10 * 2\pi / \omega h.$$

From this we obtain

$$\omega h = 120\ \omega L \qquad (61)$$

[046] From equation. (60) and equation (61) we know that means ωL is much smaller than ωh and

$$\omega L / \omega h = 0.008333$$

$$\omega h / \omega T = 1 / (1 + 0.00833^2)^{**0.5}$$

$$= 1/ 1.0000347 \sim 1$$

That is, $\omega sc \sim \omega h$

$$= \alpha / Ts - \omega sc$$

$$\omega b' = \alpha / Ts - \omega h \qquad (62)$$

[047] In the real world, the algorithm for data processing to determine collision criteria may be more complicated - not all objects on the road will result in a collision, when the height of the object is low enough, it should be defined a "bumpy " instead of collision. In terms of the real road condition, since

$$1.6 - R \sin \alpha h \leq 1/3 \, Rw$$

$$= .30/3$$

$$= 0.10 \, M$$

where R is the distance to the obstacle and Rw is the radius of the vehicle's wheels, normally be 0.3m. The longitudinal angle denoted as 'α' is obtained by a specially design semiconductor angle detecting device, in which the measured longitudinal angle is in proportional to the illuminating passing through lights. Thai is, when

$$R \geq 1.5 / \sin \alpha h \qquad (63)$$

will be judged as a collision case and be added as one of the collision criteria.

[048] To predict the collision more accurately, the system of the invention may be non-linear, that is, the distance is the function of the longitudinal angle, and the relative velocity and relative angular velocity to the obstacle can be a second order variable, as described below.

$$\omega = \omega 0 + \beta t$$

$$R = R0 + V0 \, t + \tfrac{1}{2} a \, t^{**2}$$

where β is defined as

$\beta = d(\omega b')/dt$, where

$\omega b' = \alpha / Ts - \omega h$

as shown in equation (59) and

$^{T}\omega$ is defined that after that duration the relative angle between two objects will become zero.

[049] During the driving period, disregarding any traffic site (high way, freeway, streets, local paths, parking log, ... etc.), based on the any measured data (with sampling rate 20Mhz), once the measured data R, Ts, as we as other computed data such as a, ω, β, Tr and $^{T}\omega$, meet the equations listed below, a collision with a obstacle is concluded to occur within short time (1.5s) and the proper control must be taken to avoid a collision accident.

[050] Since the data is continuously coming in and updated, the application of braking or the real situation modifies the criteria, the conclusion of the prediction about the collision may vary, hence the control action may persist, change (the strength of the braking, for instance) or cancel depending on the instantaneous computation result, but once braking starts, the control signal will be held for at least 250ms, waiting for the next reliable updated control signal. Note that all these operations are completed automatically without the driver's extra effort. Because the system keeps updating its control status every 250ms, the driver's participation will change the detecting result and the system will automatically count all these promptly in its analysis and control decision making.

$$Tr = ((V0^{**}2 - 2R0 * V't)^{**}1/2 - V0))/a \leq 1.5\ s$$

$$T\omega = \omega b' / \beta \leq 1.5\ s$$

[051] Any collision relates to a body, regardless of its material make-up, which can be metal, wood, cement, rock, plastics a human body...etc. In order to deal with the individual bodies, certain data are sampled in some critical points to determine the collision prediction.

[052] An obstacle body in the traffic environment can be a single body, such a 20cm diameter standing wire pole to support cables, a vehicle of a few meters in length, a body of a human being of 20 to 45cm width typically, or a building as wide as 4 to 100 meters. (If the data from any mass point on the body suggests a collision to occur, then we define that it is a collision.) To simplify the computation, we also assume reasonably that all points in the same body will have the same velocity, angular velocity, acceleration and their higher order derivatives. Thus, we can use these data to represent the entire body, for example, if information from these mass points does not suggest an immediate collision, then there is no collision control will be evoked.

[053] Separating the individual bodies by

$$dR/dt > Exp6$$

where t = t 1 @ dR/dt > 0 associates the starting edge of the body while t = t2 @ dR/dt < 0 associates the stopping edge of the obstacle body, since the length of the laser beam changes dramatically at these two points, while the within the same body usually not. If there is more than one time of

$$V = dR/dt > + Exp6$$

found consecutively, only the first one counts, while if there is more than one time of

$$dR/dt < - Exp6$$

found, the last one counts. All points found in this interval are regarded as one obstacle body.

Remark: The obstacle body width D looks to the subject vehicle to be

$$D \sim R * \omega sc * (t2-t1)$$

$$Ts = t2 - t1$$

[054] Start sampling by the period of 400ns (2.5Mhz) typically during the period between t1 and t2 mentioned above, so that 1.6us will sweep over an entire scanning angle. For each sampled data of "R" that associates with the body denoted as Ri, the system hardware and software will obtain, calculate and keep truck of the associated parameters, such as

$$V = d\,Rc / dt,$$

$$a = dV / dt \text{ , and}$$

$$da / dt = a' (t)$$

$$\alpha hi = f \text{ (Area being illuminated)}$$

An obstacle body will receive many times within one turn sweeping of the laser scanning, depending on the distance and its size. For example, at 90 meters away, a 18cm wide pole will receive about 16 points sampling if the repetition of the scanning laser wave is 10Mhz. Note that αhi is the look-down angle respecting to the horizontal direction and is obtained from a special device built in to the system that measures the angle through measuring the output power from a photo-sensitive semiconductor.

[055] Determine the ai, dai/dt for all points in the obstacle body. Determine the ai, vi dai/dt in the critical point. When

$$da/dt \sim 0$$

it is the critical point because at this point the a, v reflect the true value of the obstacle body. As mentioned above, the data a, v, dv/dt obtained from the same body are also applicable to other points the entire body. Hence we can judge if one, some or all of these points should resulted in an immediate collision or not.

If any one of these points within the body (does not necessarily have to be more than one) are predicted to resulted in a collision, then this obstacle body is predicted to result in a immediate collision.

[056] The five criteria below may be used in the circuit and algorithm to determine the possibility of collision for all points sampled from the "Obstacle Body" :

$$\omega b' = Ts - 1.6Exp(-1.6)$$

determine whether there is a bump.

$$Ri \geq 1.5 / \text{Sin } \alpha hi \quad (64)$$

$$V = dRc / dt \leq 0 \quad (65)$$

$$\beta = d\,\omega b' / dt \leq 0 \quad (66)$$

$$T\,r\,i = ((V^{**}2 - 2\,(Ri - Rd) * a)^{**}1/2 - V))/ V't \leq 1.5 \quad (67)$$

$$T\omega = \omega b' / \beta \leq 1.5 \quad (68)$$

Ri: m a: m/s

β: radian/sqs Tri: s

$^{T}\omega$: s Rd: m

where Rd is one half of the vehicle's diagonal, which varies with different types of vehicles (referring to the top view of the vehicle). A typical value for Rd is 2.25m. The reason to subtract Rd from Ri is that Ri, as a data obtained and computed from the system, originally refers to the distance between the center of the scanner to the target where the laser beam strikes in that particular sampling. Since the collision will occur between the nearest portion of two vehicles at the beginning of collision, not between the scanner and the obstacle target spot where the laser beam reaches, this conversion is necessary. One half of the diagonal is just an approximated model to simplify the computation. This way we exchange great convenience in the system's calculation with a small and acceptable error. The sub "c" denotes the critical point, where da/dt reaches its minimum. We assume the value of a'(t) falls into an interval as below at this time,

$$0.001\ m/s^{**}3 < a'(t) = d\,(da/dt)\,/dt < 0.1\ m/s^{**}3$$

[057] Note that the ωh in equation (62) is replaced by ωsc, which stands for relative horizontal component of the angular velocity of the scanning laser beam defined in equation (62) and it relates to the longitudinal component and the resultant component ωh by

$$\omega bi' = \alpha / Ts - \omega sc$$

[058] This set of five data is associated with one mass point in the body and if all of them meet the above equation set, this mass point will result in a collision, hence, this obstacle body is judged to result in an immediate collision.

[0019] F in below stands for the applied force of vehicle braking while Fmax is the available maximum force used for braking, in the unit of "N".

$$F = Fmax (1. 5 / T) \qquad (69)$$

Were T is the time pending to collision, in the unit of "s".

[059] To cope with a bumpy road

$$F = K1*Fmax (h **K2) \qquad (70)$$

$$0 < h < 0.10 \text{ m}$$

$$0.05 < K1 < 5$$

$$0.1 < K2 < 0.5$$

where K1 and K2 are two constants and H is the height of the obstacle detected, in meters.

Rf stands for the distance obtain

[060] It should be understood, of course, that the foregoing relates to preferred embodiments of the invention and that modifications may be made without departing from the spirit and scope of the invention as set forth in the following claims.

I CLAIM:

1. A vehicle collision avoidance system comprising:

a rotating pulsed infrared laser beam scanner apparatus for generating a first signal representative of an obstacle;

a processing circuit coupled to the rotating pulsed infrared laser beam scanner apparatus for processing the first signal and generating a plurality of signals;

a processor coupled to the processing circuit for processing the plurality of signals and generating a braking signal; and

a braking apparatus responsive to the braking signal.

2. The vehicle collision avoidance system of claim 1, wherein the rotating pulsed infrared laser beam scanner apparatus rotates in a horizontal plane and a vertical plan simultaneously.

3. The vehicle collision avoidance system of claim 2, wherein the rotating pulsed infrared laser beam scanner apparatus rotates in the horizontal plane at 48 revolutions per second and with a period of 20.83ms and in the vertical plane at 8 sectors per second and a period of 20.83ms.

4. The vehicle collision avoidance system of claim 2, wherein the rotating pulsed infrared laser beam scanner apparatus is operable to scan an object from 1.6m to 120m.

5. The vehicle collision avoidance system of claim 1, wherein the rotating pulsed infrared laser beam scanner apparatus emits a laser beam having 28.45W peak power, a wavelength between 1um and 1.550 um excluding the region between 1.3um to 1.4um, a 1.0ns pulse width, and a 10Mhz to 110Mhz repetition rate.

6. The vehicle collision avoidance system of claim 1, wherein the rotating pulsed infrared laser beam scanner apparatus has a minimum peak power value of about .104W and a reserved peak power of about 28.45W.

7. A method of avoiding a vehicle collision comprising:

determining features of an obstacle using a rotating pulsed infrared laser beam scanner apparatus;

processing signals representative of the determined features; and

braking the vehicle in the event the processed signals indicate an imminent collision.

8. The method of avoiding a vehicle collision of claim 7, wherein the rotating pulsed infrared laser beam scanner apparatus rotates in a horizontal plane and in a vertical plane simultaneously.

9. The method of avoiding a vehicle collision of claim 7, wherein the rotating pulsed infrared laser beam scanner apparatus emits a laser beam having a wavelength between 1um and 1.550 um excluding the region between 1.3um to 1.4um, a 1.0ns pulse width, and 10Mhz to 110Mhz repetition rate.

10. The method of avoiding a vehicle collision of claim 7, wherein the rotating pulsed infrared laser beam scanner apparatus has a minimum peak power value of about .1W and a reserved peak power of about 28.45W.

11. A method of avoiding a vehicle collision comprising:

detecting circumferential obstacles as bodies;

obtaining data from a rotating pulsed infrared laser beam scanner apparatus including a time when the beam reaches a first edge of the obstacle and a time when the beam reaches a second edge of the obstacle;

determining a relative distance from the scanner apparatus to the obstacle; and

8 determining a time to collision with the obstacle.

VEHICLE COLLISION AVOIDANCE SYSTEM AND METHOD

ABSTRACT OF THE DISCLOSURE

[061] A vehicle collision avoidance system includes a rotating pulsed infrared laser beam scanner apparatus for generating a first signal representative of an obstacle; a processing circuit coupled to the rotating pulsed infrared laser beam scanner apparatus for processing the first signal and generating a plurality of signals; a processor coupled to the processing circuit for processing the plurality of signals and generating a braking signal; and a braking apparatus responsive to the braking signal.

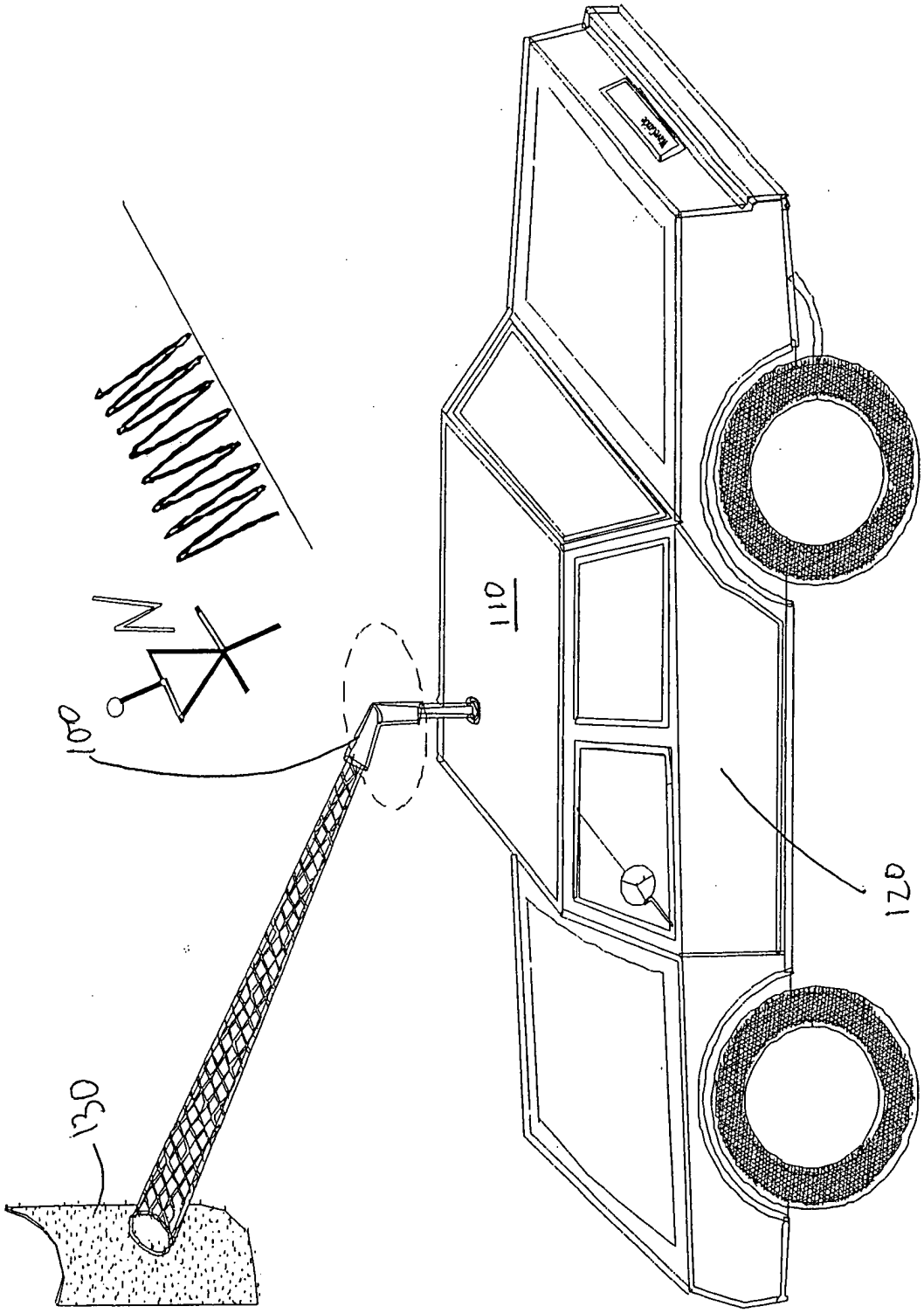


FIG. 1

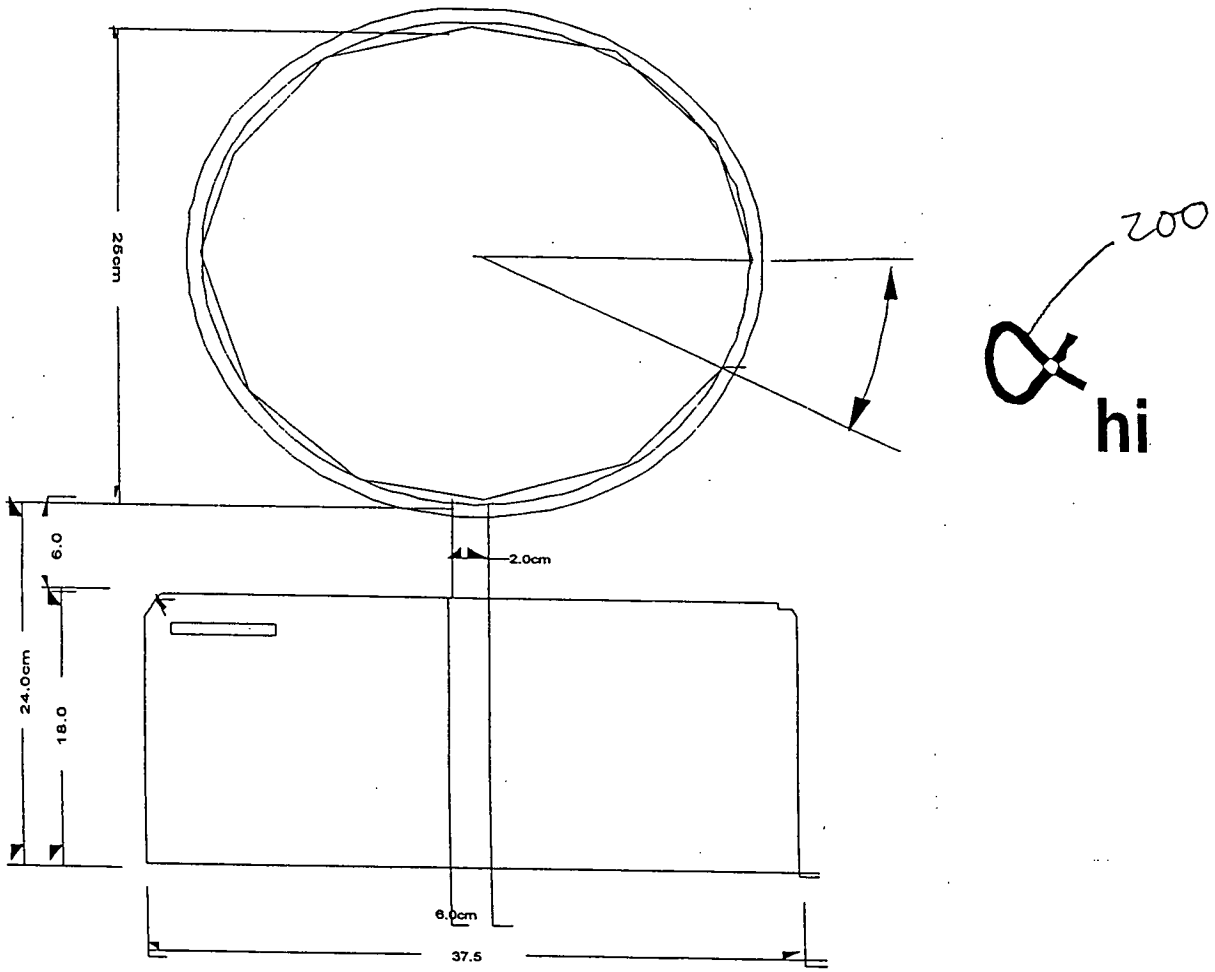
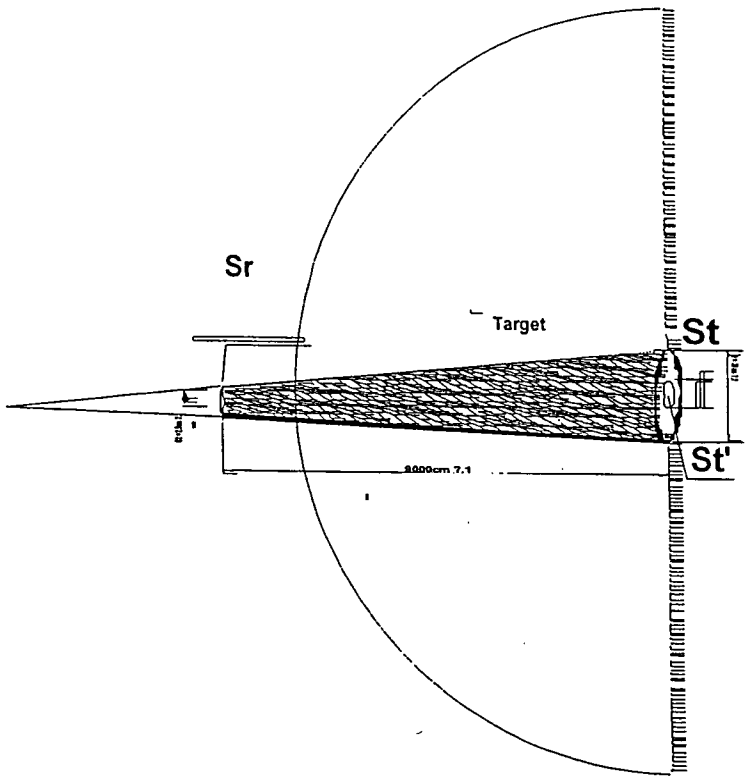


Fig. 2



Efficiency = 25%* (St'/St) (Sl'/Sr)=

- Assuming all reflected energy is spreading over a half-sphere
- Assuming target absorbs 75% of the insertion energy
- Assumeing laser target be a 20 diameter ball

St: Targer area as beam capacity, with Dt = 120cm.

St': Ttarget area when striking over a real obstacle, with Dt' = 27.65cm.

Sl: optical len area, with Dl = 2.5cm.

Sr: area that reflected wave cover, assuming to be half sphere

with D = 180 Meters.

St = Pi Rt**2 = Pi (0.60**2) = 1.13 (Squre Meter)

FIG 2A

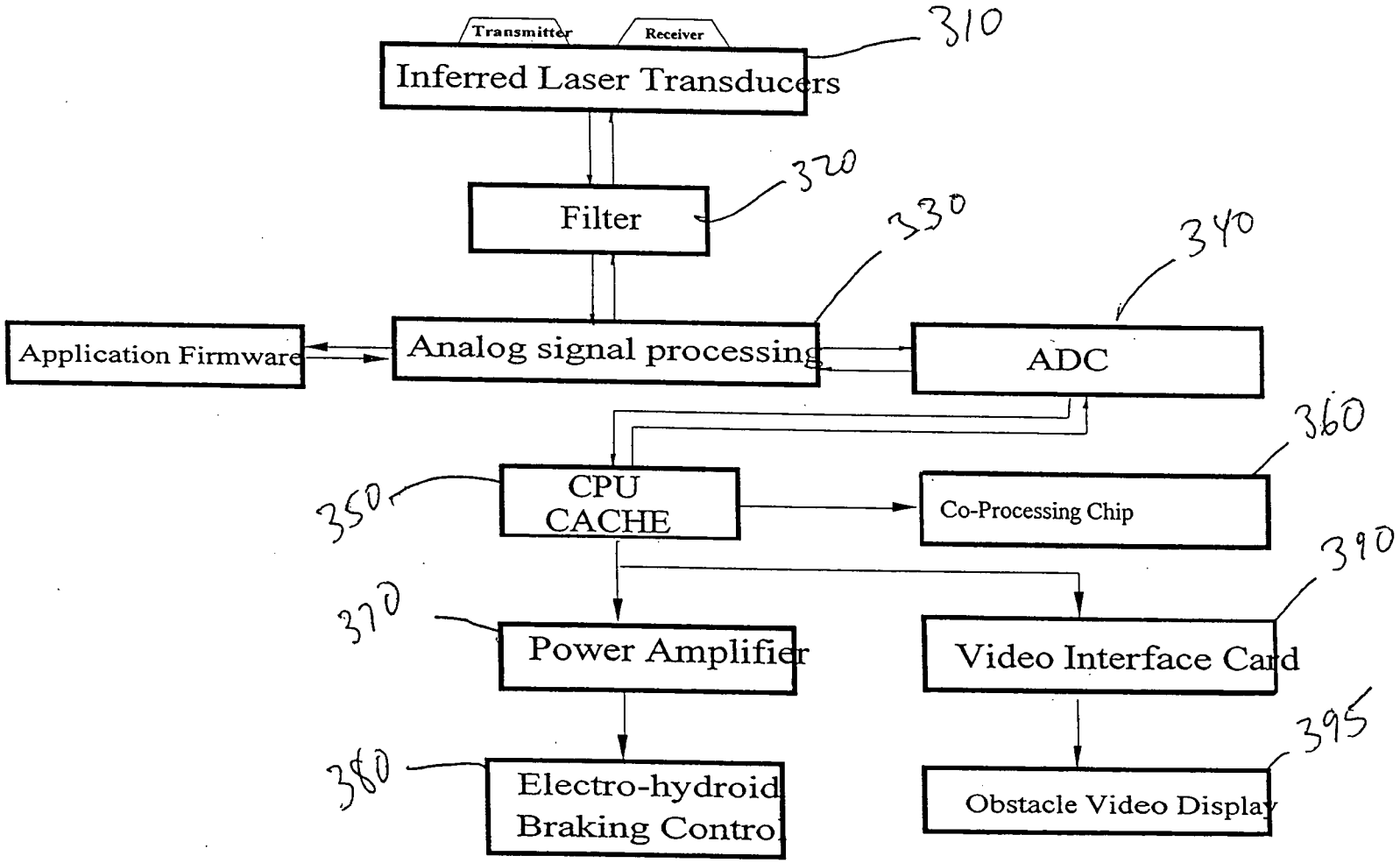

Transmitter
Receiver
Inferred Laser Transducers
310
Filter
320
330
340
Application Firmware
Analog signal processing
ADC
360
350
CPU
CACHE
Co-Processing Chip
390
370
Power Amplifier
Video Interface Card
395
380
Electro-hydroid
Braking Contro
Obstacle Video Display

FIG 3

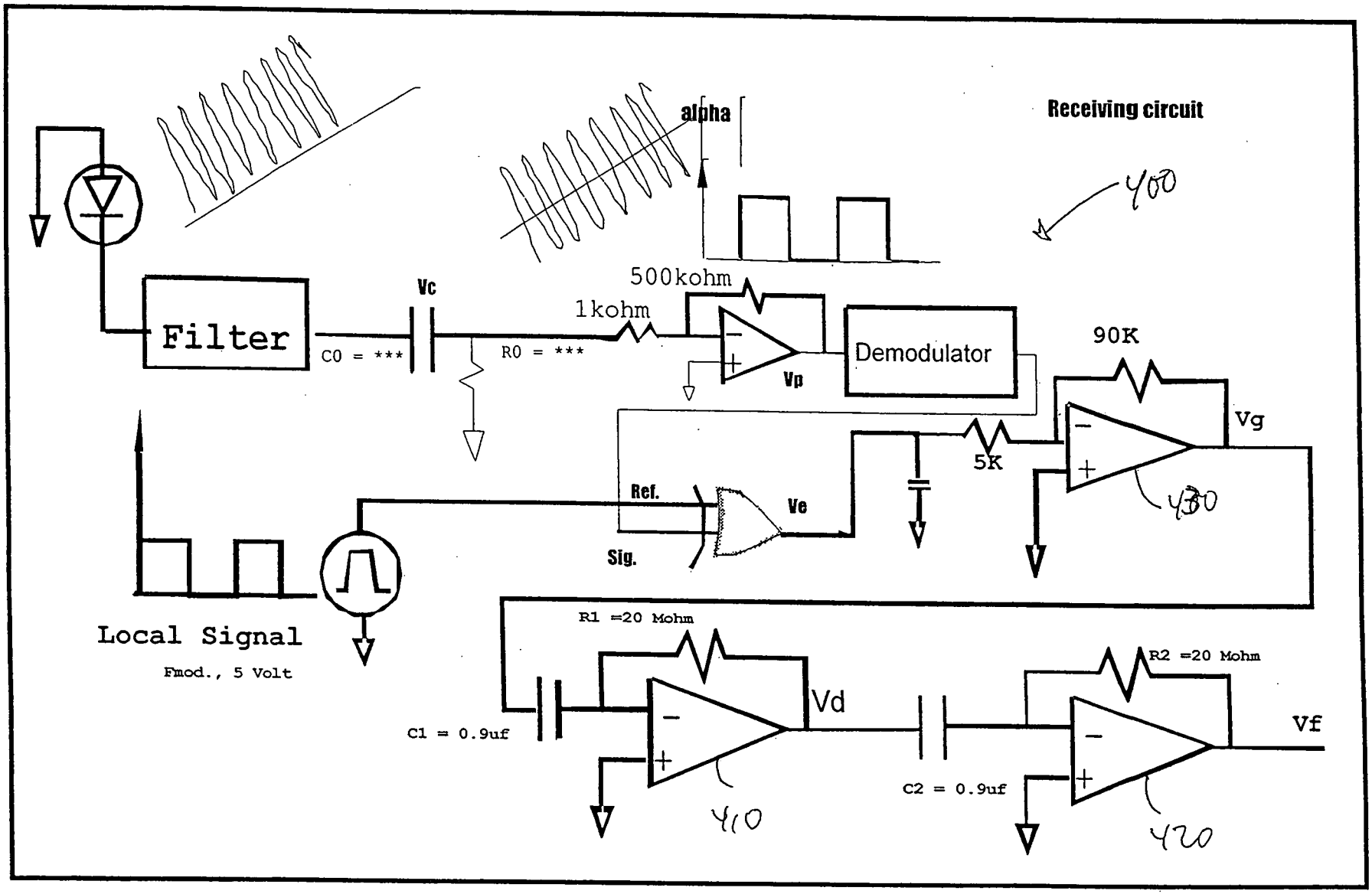

alpha
Receiving circuit
400
Filter
Vc
C0 = ***
R0 = ***
1kohm
500kohm
Vp
Demodulator
90K
Vg
5K
430
Ref.
Sig.
Ve
Local Signal
Fmod., 5 Volt
R1 =20 Mohm
Vd
C1 = 0.9uf
410
R2 =20 Mohm
Vf
C2 = 0.9uf
420

FIG. 4

(1) When Vf '= (Vd /dt)/dt < 20m/s**3, timer starts and t1 is recorded. ← 510

(2) Record Vr and a at this time: ← 520

Vr = dR/dt = 18 dVe/dt = Vd

(3) When Vf = 0 again, timer stops and t2 recorded.. ← 530

(4) Find Ts ← 540

Ts = t2 - t1

(5) Determine Q ← 550

Q =T s - ∝/ω Scanner

(6) Find Tc (Time to Collision occuring) ← 555

Tc = R / Vr

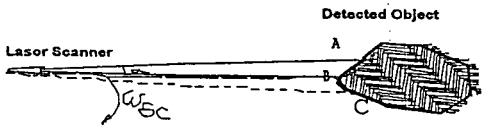
(7) Quoteria factors for Collision Judgement ← 560

(a) Set L = 1 if Q = 0 and L = 0 if Q = 0
M = 1 if Tc < 0; and M = 0 if Tc > 0
Set N = 1 if ABS of R/Vr < 2, and N = 0 if ABS of R/Vr > 1.5

(b) K = L * M * N

(8) K = 1, Collision will occur and immediate braking required; ← 570

K = 0; No collision will occur shortly, no braking control action required.



Notes 1: When laser scanning beam (the front of the wave bandle) sweeps from AB to BC, which represents the relative speed at this case.

Note 2:Mechanical control is based on judgement on above logic sequence.

Note 3: With scanner continuously sweeping, all parts of any obstacle will detected and treated.

Note 4: This is the fundamental model algorithm, for detail and practical , please refer to table 6: Signal Process and Operation Time

Fig 5

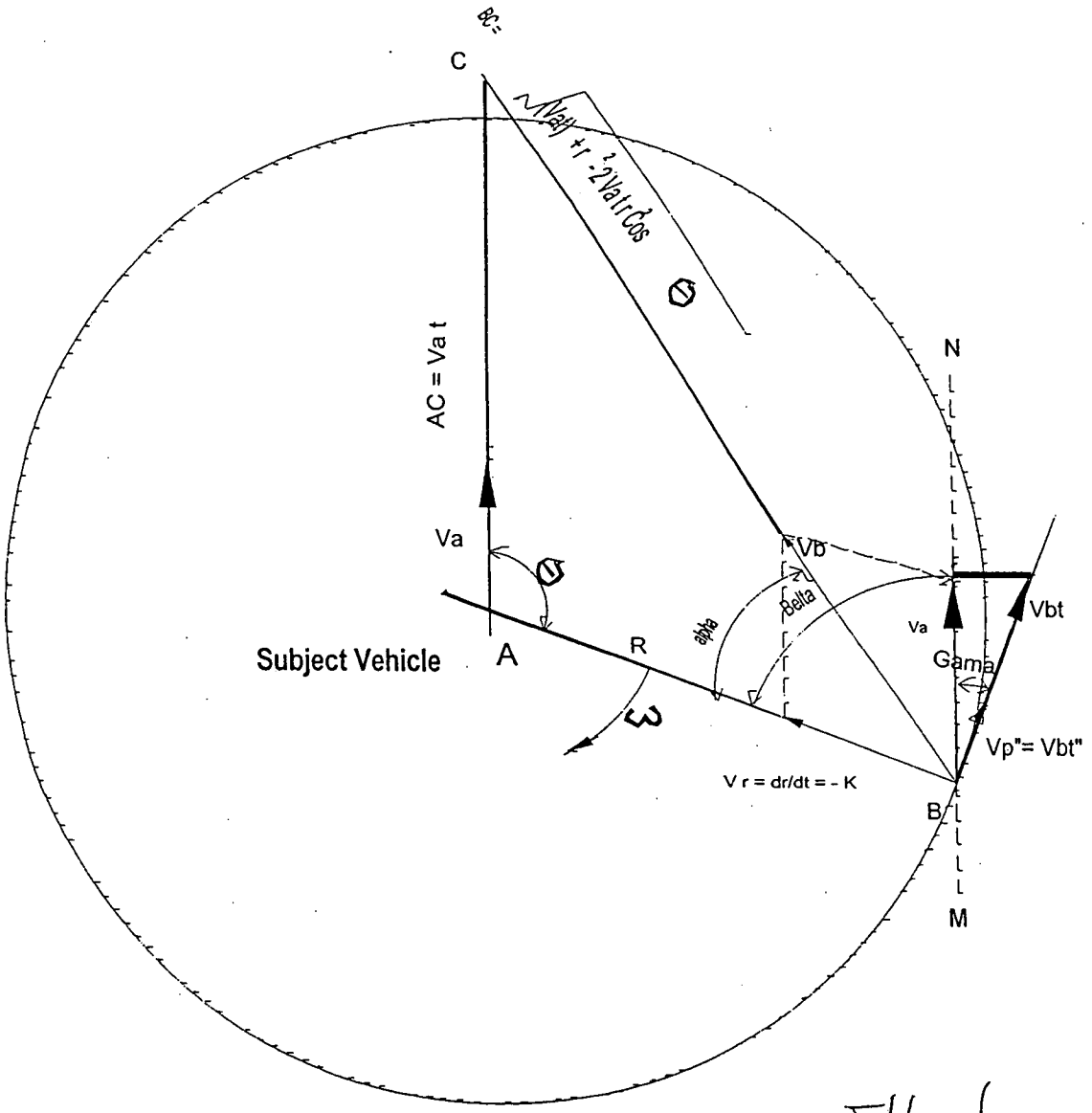

C
AC = Va t
Va
Subject Vehicle
A
R
alpha
beta
Vb
N
Va
Vbt
Gama
Vp"= Vbt"
V r = dr/dt = - K
B
M

FIG. 6

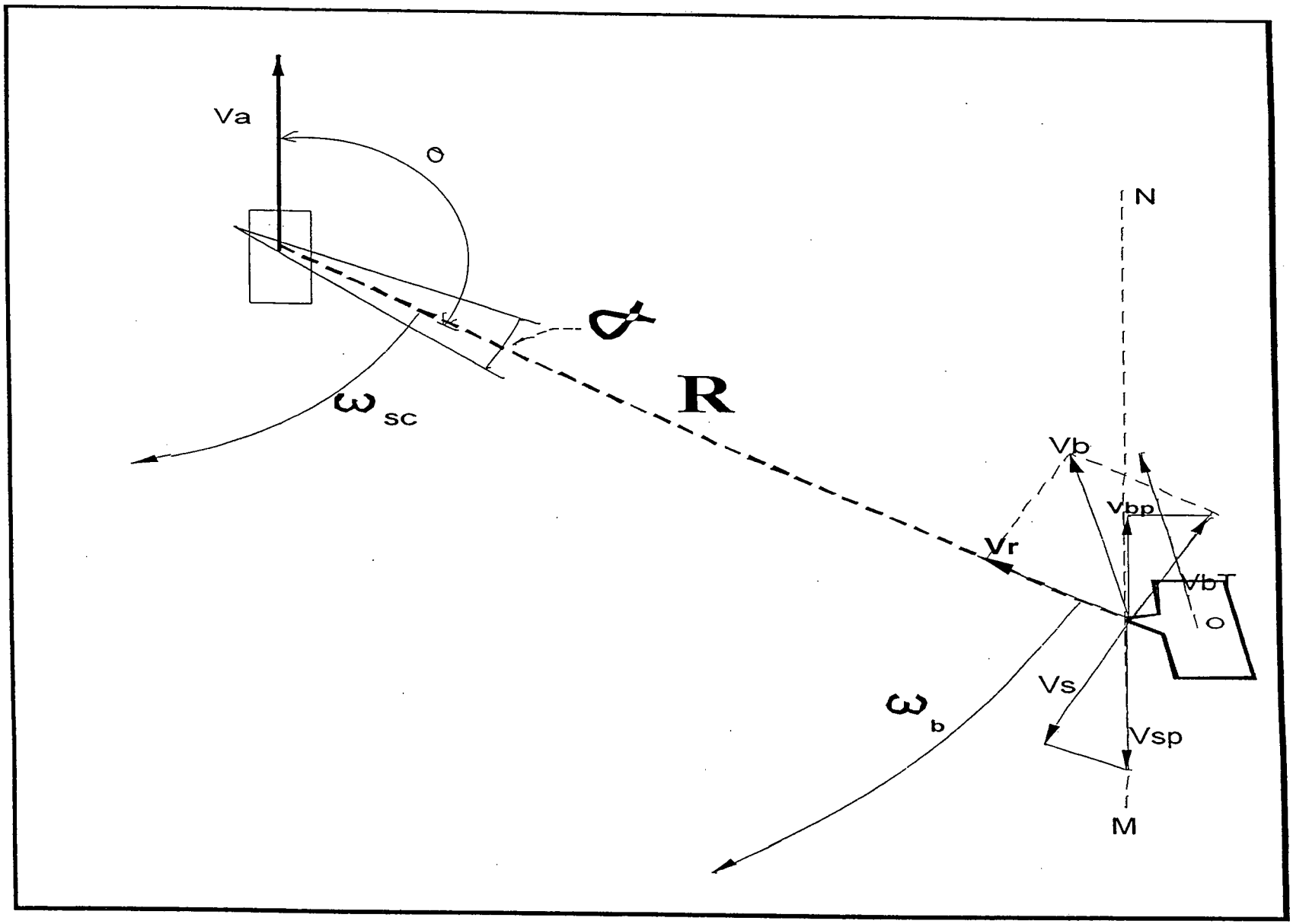


FIG 7

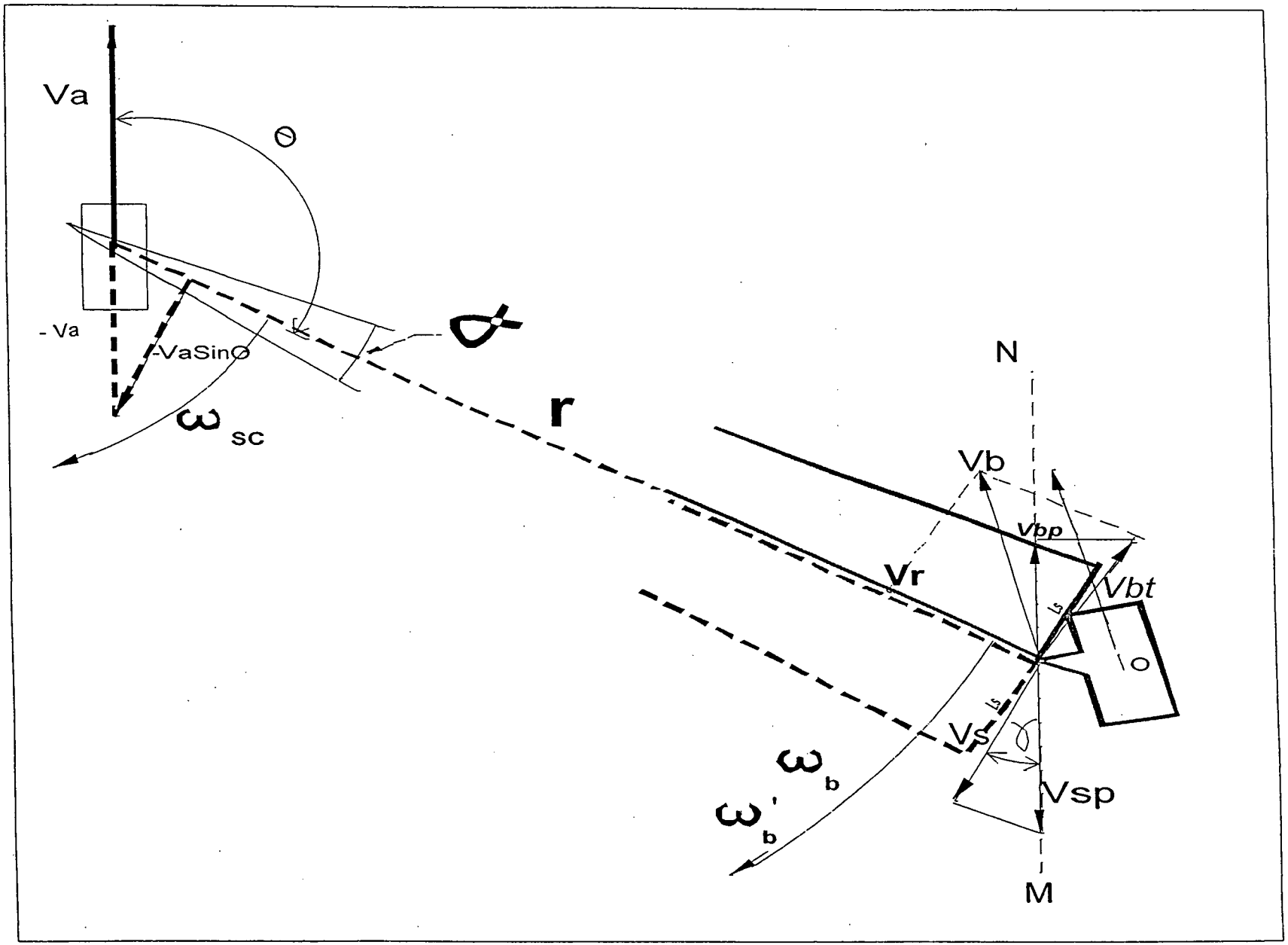


Fig 8

File Index

Amendment and Response to 2nd Action of USPTO

Name of the Doc.	Date Created	Provider	Status
Amendment and Response to USPTO	08/11/2005	Baojia Huang	Applicant
More Comments on my Response	08/11/2005	Baojia Huang	Applicant
Applicant's Data			
Serial Number			
Revocation of Power	8/10/2005	Baojia Huang	Applicant
Interview Summary	7/26/2005	Michael J Zanelli	Examiner of USPTO
2nd Action of USPTO	05/23/2005	Eric M. Gibson	USPTO
Interview Request Form	07/06/2005	Douglas Mackenzie	Fortune Law Group
Reference Prior Arts	10/20/2004	Eric M. Gibson	USPTO
Response to 1st Action to USPTO	02/06/2005	Douglas Mackenzie	Fortune Law Group
1st Action of USPTO	10/20/2004	Eric M. Gibson	USPTO
Original Patent Application Files	07/03/2003	Douglas Mackenzie	Fortune Law Group

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/613,885	07/03/2003	Baojia Huang	AWG 001	6866

7590 07/29/2005

FORTUNE LAW GROUP
#315
100 Century Center Ct
San Jose, CA 95112

EXAMINER	
GIBSON, ERIC M	

ART UNIT	PAPER NUMBER
3661	

DATE MAILED: 07/29/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Interview Summary

Application No.	Applicant(s)	
10/613,885	HUANG, BAOJIA	
Examiner	**Art Unit**	
Eric Gibson	3661	

All participants (applicant, applicant's representative, PTO personnel):

(1) *Michael J. Zanelli on behalf of Exr. Gibson*. (3)_____.

(2) *Douglas Mackenzie (38,955)*. (4)_____.

Date of Interview: *26 July 2005*.

Type: a)☒ Telephonic b)☐ Video Conference
c)☐ Personal [copy given to: 1)☐ applicant 2)☐ applicant's representative]

Exhibit shown or demonstration conducted: d)☐ Yes e)☒ No.
If Yes, brief description: _____.

Claim(s) discussed: *N/A*.

Identification of prior art discussed: *N/A*.

Agreement with respect to the claims f)☐ was reached. g)☐ was not reached. h)☒ N/A.

Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: *Informed applicant the examiner of record (Gibson) was on leave. Indicated since application was after final, entry of any proposed changes to the claims would be subject to after final practice (i.e., require further search/consideration). Indicated applicant should formally file a response which would be reviewed by examiner Gibson or this examiner depending on when the response is received*.

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims allowable, if available, must be attached. Also, where no copy of the amendments that would render the claims allowable is available, a summary thereof must be attached.)

THE FORMAL WRITTEN REPLY TO THE LAST OFFICE ACTION MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a reply to the last Office action has already been filed, APPLICANT IS GIVEN ONE MONTH FROM THIS INTERVIEW DATE, OR THE MAILING DATE OF THIS INTERVIEW SUMMARY FORM, WHICHEVER IS LATER, TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW. See Summary of Record of Interview requirements on reverse side or on attached sheet.

Examiner Note: You must sign this form unless it is an Attachment to a signed Office action.

Examiner's signature, if required

Date: June 25, 2005

Patent App. file: 10/613,885
By Applicant: Baojia Huang
Tel: 408 739-1888
Email: baojia@sbcglobal.net

My Response to Office Action of USPTO

1. **About Claim Rejections – 35 USC/ 102**

Claims 1, 3, 4, 7 and 8 are rejected under 35 USC 102 (b) as being anticipated by Hósokawa et al. (US005864391A)

One of the important ideas in my vehicle collision avoidance system to distinct from that of Hosokawa's, is to detect the objects circumferentially, which means to detect objects surrounding the host vehicle, through out all time whenever the host vehicle is operating, from near region such as 1.6meters, to far end such as 120 meters from the dual rotating infrared laser obstacle scanner in the invented system. While on the system of Hosokawa's invention, the protecting scope is limited for "frontal object" only, although its (hexagon) reflecting mirror in his proposed scanner is rotating circumferentially, it is no sending, nor receiving laser beam to and from all directions. Please refer to fig. 1 and Fig.2 and all other exhibited figures, the produced beam reflected by mirror M3 to one side of rotary polygon M1 only constantly, and note that, since the beam reflected from M1 can only change a certain degree of angle, which is no more than double of the angle for one side of the polygon mirror to turn over during its light-accepting period, that is

$$\theta \text{ Emitting} < 2^* 360/n = 2^*360°/6 = 120°$$

Where n is the number of sides of the polygon, n = 6, this is the maximum scanning angle Hosokawa's laser scanner system can make. There are several areas in Hosokawa's invention file that support this point, as listed below:

In the Abstract, it states: "... so that the pulse beam is reflected as a transmission beam advancing toward a measure area in a forward direction. "

a) From Fig.5, we can see clearly that the monitoring area of the reflected beam is limited to area denoted as "81", hence the area being detected can only along the vehicle traveling direction, as the term "frontal position" described in Hosokawa and Maruko's patent files (Even with 90° insertion angle, the reflected light is limited to 180 ° scanning range only!)

b) In the "Fields of the invention" section under "Background of the Invention", it says: " This invention relates to a radar apparatus detecting a preceding object ...".

c) In colume2, line61 of the patent file 5864391 of Hosokawa, it says: " According to the feature of preferred embodiments of the present invention, the pulse beam Lin is irradiated to the mirror surfaces of the rotary polygon mirror M1 at the angle Φh in a range of +- 48° with respect to YZ plane in the given three dimension system".

d) In colume4, line1 to line3, "so that the pulse beam is reflected as a transmission beam advancing toward a measured area in a forward direction".

...

Still, may other places found his patent file proves that Hosokawa's invention if for "frontal object" only, no matter detecting purpose, structure, or the way said Hosokawa's scanner woks.

2. **Claims 5 and 9 are rejected under 35 USC 103(a) as being unpatentable over Hosokawa in view of Sizer, ii (US4737958A).**

My circumferentially object scanning, pulsed infrared laser system is a so arrange that it can perfectly meet so many challenging demanding from the engineering and safety requirements, In fact, to be safe or not still depends how the laser is designed and operated, because it has to do with many things, such as peak power level, average power level (or pulse density level, equivalently), the time and the area to strike in human's eyes (iris); while all these has to accommodate with the current technologies and the supplying of industrial components. **Several aspects in my invention are supported mutually forming an integrated body to assure my design of vehicle collision avoidance system to be functioning, safe and practical.** The heavy work has taken me quite a few years to build up such laser model must to deal with tremendous complicated issues, some typical features are listed in more detail as following:

- **Most safe to human and most affordable in present industrial supplies**

Centralized at 1.54um, also being called infrared laser is the proposed laser wavelength in my laser scanner, the most important reasons behind is that it features both safety and highly focusing ability – possessing noise immune property and lowest hazard (harm) to vehicle drivers and the people who appear on the scanning zone. (Infrared laser beam strikes right at the desired objects with much more focus degree than most of other type of waves). In addition to safety feature, laser components with this wavelength (1.54um) is a standard in today's industry and thus most affordable in its price.
This is neither proposed by government, nor Sizer or other existing technology.

- **Sensitivity in detecting and economics in power consuming**

Based on a use of a standard 1nw sensitivity of infrared laser sensor, under constrain of detecting functionality (such as 18cm diameter of target area over 90 meters distance) stated in table 1, table 2 and table 13 in my patent application file, my system adapt a proper power range from about 10.4 to 28.45 watt peak power be strong and lowest cost in terms current component level, which is suppose being able to cope with rainy, middle degree of foggy and snow weather, different roughness of object surface, various materials and irregular shapes, as well as the reflecting size and the object's locating distance, ... - all these factors cause the selection of solution set to become a extremely difficult task.
This is neither proposed by government or Sizer, nor other existing technology.

- **Sharpness of object detection enhances the ability of object selection**

My object detecting laser beam is adapting 0.002radians as the narrow diverging angle on the emitting laser beam, so as to distinguish detected potential objects frequently encountered in traffics that also meets the requirements for far and near, big and small, in a optimal compromised manner;
This is neither proposed by government or Sizer, nor other existing technology.

- **Selectivity to avoid disturbance from external laser scanning source**

Selectivity refers to pick up the returning laser signal from original emitted laser scanner among while expel laser scanning signals emitting from other vehicles, either same system or different system. This system establishes about 1,000 channels, from 10Mhz to 110Mhz with typical bandwidth of 100khz for individual system built in the vehicle, to avoid disturbance from laser scanning systems from other vehicles in the traffic, at the mean time it immunes many other non-system noise signals.
This is neither proposed by government or Sizer, nor other existing technology.

- **Pulse density for safety and energy**

Higher amplitude for the pulses of scanning laser beam incorporated with low density of pulse concentration, thus reduce the average power while still maintain enough sensitivity. In addition to this, low power consuming is also achieved with such design: about 1ns pulse width inserting to every 10ns up of repetition period – low density of pulse configuration.
This is neither proposed by government or Sizer, nor other existing technology.

- **Fast rotation to achieve fast reaction**

About 3,000 rpm on horizontal plane and 480rpm on vertical plane of laser scanner to ensure the promptly react and handle the rapid changing traffic dynamically.
This is neither proposed by government, nor Sizer or other existing technology.

- **Enhancement of eye-safety by dual rotation**

Rotation of the laser scanner, especially dual rotation of the laser scanner enhances the eye-safety further more, attributing to dual rotation causes the duration of the laser beam to stay even shorter time, comparing with any non-rotation type of laser scanners.
This is neither proposed by government or Sizer, nor other existing technology.

- **Modulation accommodates with distance**

833.33khz is used for distance modulation in the electronic signals processing unit, which can accommodate with distance ranging purpose to provide best dynamic range for the phase-shift distance ranging. (About 1.2us for an around trip of laser beam's traveling time associated with 90 meters detecting range).
This is neither proposed by government or Sizer, nor other existing technology.

Government regulates the average scanning laser power after the IR pulsed laser was proposed, such as **Sizer, ii,** but still many associated important methods must be follow up at the mean time before this new technology to be adopted as shown above. To balance and bring a system consisting such complicated and mutually conflict factors into such a harmonic state, hence such new arrangement on the detecting laser should be a significant progress in vehicle collision avoiding field. All above configuration and arrangement of the laser constitute a practical and completed solution, which is unique, novel and useful, comparing with any other existing prior arts.

3. **Claims 11-15, 18, 19, 21, and 22 are rejected under 35 USC 103(a) as being unpatentable over Hosokawa in view of Maruko et al. (US20020091479A1).**

There are at least three most important features that distinct my method with any other prior arts:

i. **Those prior arts, including that of hosokawa and Maruko, do not cover objects that are outside of their "frontally locating" range, while my invention**

create a computing method that will deal with objects exist or come from areas in any other directions. While in any prior system, they neither detect such objects, nor provide means in dealing with such situations, since those systems and methods just simply don't count in a factor - the lateral movement of the objects - the lateral velocity and displacement, and the omission of such factor will generate mistake in their computing and prediction about if a collision will occur soon or not, especially in the case when the object is relatively far (note that far of object does not establish safe condition automatically, since the relative speed can be very large).

ii. **Further more, the speed together with the acceleration relative to the front object are not enough to predict the lurking collision, since that, to any two relative moving bodies, there always exist vertical approaching and lateral approaching two components.**

Although both components not always exist at the same time - the object may have lateral movement that is, by the time (after the data collection, analysis and judgment by the system unit), two objects vertically predicted to come together and touch (collision), may have laterally displacement during the elapse time, and for that reason in fact the predicted collision will not happen! Therefore ignoring the lateral component (in terms either distance and velocity) is certainly a mistake, at least is a unreliable system, and this problem actually exists in all prior arts including that of Hosokawa and Maruko.

Maruko's method proposed a criterion to evaluate the degree of collision tendency, intending to using the relative angle between host vehicle and front objects and the change rate of relative angle and by this two factor he compute the time leading to collision. By this method he attempts to overcome the operation of braking by a mistake: He proposes to judge the presence of lane-change intention by $\alpha 2$ ($\alpha 2$ = TA), as he uses the relative angle value and change rate of the relative angle to determine the relative angle time TA. Maruko considers that having a shorter TA (a smaller value of relative angle for the same angle change rate, or larger angle change rate for the same relative angle) implies that in shorter time the host vehicle will be running into the same lane of frontal vehicle, hence a large change of direction, which means a larger value of difference in curvature should be required for the host vehicle.

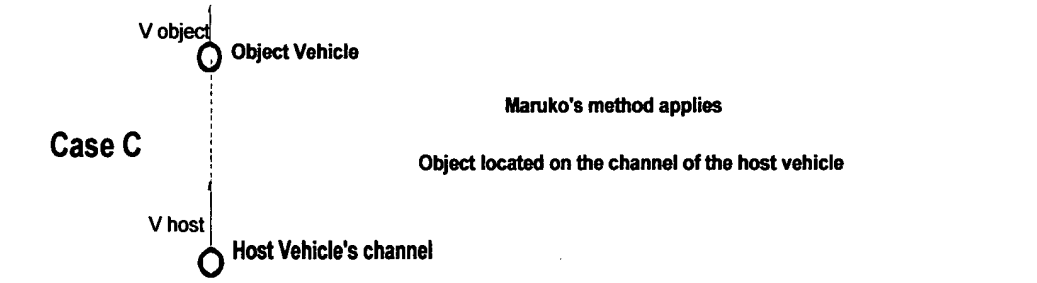
This should be right in the case wherein objects lie in the same channel with the host vehicle (referring to Case C in the appendix attached to the end of this article), for other circumstances, Maruko's method will be totally invalid. Because if the object vehicle lies on the channel of the host vehicle, the relative angle between these two vehicles stands for the tendency of their departure from each other (or simply say, they tend to run away instead of coming closer and hit each other). In this case, larger relative angle is better and Maruko's rule works, but when in the case that the object does not lie on the channel of the host vehicle, then there is no such relationship- some times larger relative angle means quicker and heavier collision! Let us exam and compare case A with case B (referring to Case A and Case B illustrated on the appendix attached to the end of this article). In case A, two vehicles apart with certain distance (say 5 meters) run in such way that, say, they are having a relative large angle of 45°; while in case B, everything the same, including the change rate of their relative angle, except the two vehicle's relative angle is 10°. Case A is having larger relative angle, TA in case A is larger, since their change rate of relative angle are the same. According to

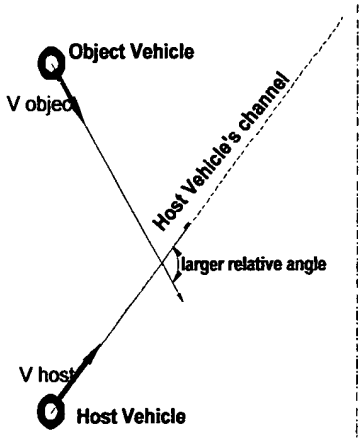
Maruko, refer to fig.13 in US 2002/0091479 A1, as Maruko's proposal, larger change (larger $\Delta\rho$) in curvature is not required for case A, because case A has larger TA, and larger TA corresponds to smaller α, hence case A will require smaller curvature which implies that lane change should not be that urgent comparing with case B. But in fact, larger relative angle should make case A to have a collision sooner and even heavier, since the two vehicles in case A will come closer sooner, and they will have larger impact force during the time of their collision, since their relative angle is larger. From this case we can see that prediction about vehicle's collision obtained by Maruko's method could be a mistake and hence Maruko's method is not a reliable method in dealing with objects located at areas deviated from the original channel of the host vehicle.

One of the main purposes for my invention is to overcome this problem. A solution to this is to find out the relative angular velocity, and use it to compute and predict the horizontal movement of the objects under detecting. This method is sited my patent application file, detailing on [042] to [062], while there are (66) and (68), combined with (64), (65), and (67) serving for the collision judgment purpose.
This is a totally unique and unobvious method comparing with any prior arts.

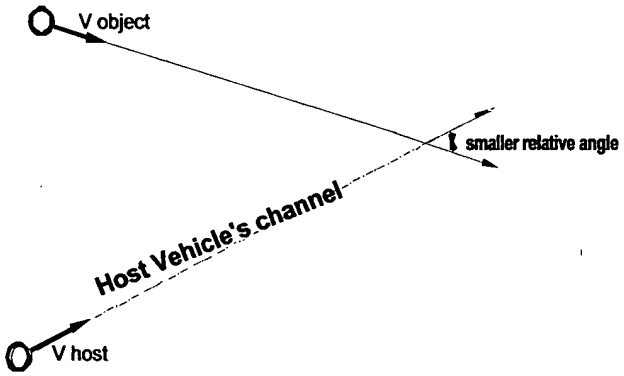
iii. In order to obtain the lateral movement component (lateral relative speed) and to obtain accurate relative vertical speed, I propose "critical point method" where a particular vertex on the surface of scanned body is identified by a special method (that is, scanned distance data r (t) is taken twice derivative continually by an analog circuits built in the hardware system, and the result is evaluated and identified once its value is small enough comparing with a pre-given threshold. This method to construct to avoid errors produced due to the irregular shape of the scanned surface, since the scanning laser beam is swiping over the surrounding objects, instead of stay at a fix point, and that will cause error in the relative speed's detection, since the distance is generally different at different point on the object, and the variation of distance at different point of the object surface will generate error to the relative speed as well as other parameter computed based on it. This "**critical point method**" is then proposed to remove such kind of error in my scanning obstacle detection.

Appendix: Illustration to Show Why Maruko's Method Is Limited





Case A



Case B

Maruko's method becomes invalid when the object vehicle is not on the channel of the host vehicle. Look at case A, larger TA doesn't mean more safe, it requires larger curvature to escape from collision; while in case B, TA is smaller but it doesn't require a larger difference in the curvature to make a quick change in its direction.!

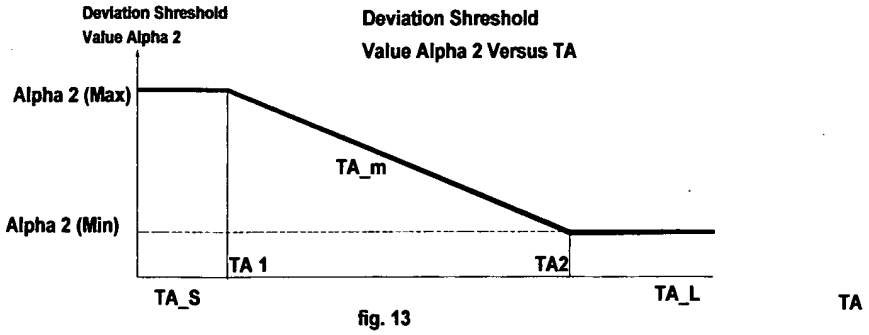


fig. 13

Maruko's figure shows that the difference of curvature has inverse relationship with Relative Angle

Time TA - larger TA should have smaller change in curvature, or vise versu.

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REVOCATION OF POWER OF ATTORNEY WITH NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

Application Number	10/613,885
Filing Date	July 3, 2003
First Named Inventor	Baojia Huang
Art Unit	3661
Examiner Name	Michael J. Zanelli
Attorney Docket Number	AWG001

I hereby revoke all previous powers of attorney given in the above-identified application.

[ ] A Power of Attorney is submitted herewith.

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☐ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96)

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NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☑ *Total of 1 forms are submitted.